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"*To the solid ground*
Of Nature trusts the mind that builds for aye."—WORDSWORTH.

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A WEEKLY JOURNAL OF SCIENCE

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SATURDAY, JULY 2, 1932

CONTENTS

River Gauging and Flood Prevention

THE recent floods in the Midlands, with their resultant enormous material damage and, in one or two localities, regrettable loss of life, have again directed public attention to one of the most serious and difficult problems connected with the efficient drainage of inland districts, namely, the regulation of river flow. Rivers, as a class, are notoriously erratic in their behaviour. Sometimes, in seasons of prolonged drought, they scarcely provide sufficient water for the minimum requirements of trade and agriculture ; at others, they transform themselves into raging torrents sweeping everything before them in an orgy of havoc and ruin. The control of such violent natural forces is an essential duty of civilised communities, in the interests not only of farming and transport but also of public safety. It is characteristic, however, of British methods, that, hitherto, there has been no properly organised or systematic study of the range and extent of river floods, and no national or authoritative collection of stream-flow data upon which reliance could be placed for a scientific investigation of their incidence. Certain important bodies (few in number), such as the Thames Conservancy, have carefully maintained an efficient service of river gaugings —the records at Teddington Weir are admirable— but, generally speaking, Conservancy Boards have had few or no resources available for expenditure of this kind. It is quite true, also, that, in a number of instances, individual initiative has set on foot the compilation of local data and the taking of observations which, within their limitations, are, no doubt, capable of affording much serviceable information, but these efforts are regrettably

spasmodic, and, unless carried on under supervision of unimpeachable reliability, call for careful scrutiny and independent confirmation.

As an outstanding instance of competent individual enterprise may be instanced the operations during the last few years of the private organisation known as River Flow Records, promoted by Capt. W. N. McClean, who, himself an authority on the subject, has at his own expense maintained a staff of operators to gauge and record the flow of streams in the Ness Basin, Inverness-shire. That the cost of obtaining and collating such records for public service should come out of the pockets of individuals is manifestly unfair, and, indeed, it constitutes a financial burden such as cannot generally be borne, nor, if taken up, can it be sustained for any length of time. The organisation in question was undertaken for the purpose of giving practical illustration of the manner in which gauging records of the principal water areas of Great Britain may be kept, and it has issued a series of quarterly reports giving the readings taken, with a statement of the difficulties encountered and the means by which they were overcome. New bodies, responsible for the carrying out of such duties, will do well to acquaint themselves with the methods employed in connexion with the gauging of the Ness, the Garry, and the Moriston.

Other work, of a collective nature, has been done under the auspices of the leading technical institutions, not strictly confined to the question of flood prevention, since river-flow records are essential to a number of objects: irrigation, transport, water supply, etc. The Institution of Civil Engineers in March 1931 appointed a Committee "to examine the present state of knowledge in regard to the magnitude of floods in relation to reservoir practice in Great Britain and to make recommendations on the best methods of dealing with them in that connexion". During the past twelve months, this Committee has been pursuing inquiries in order to discover the evidence available, and the information, when published, will undoubtedly be of great value. The Council of the Institution of Water Engineers, in pursuance of a resolution passed at a general meeting of the Institution in December 1927 directing attention to "the urgent need of an organisation which will ensure a continuous record of the flow and storage of surface and underground water", appointed a Committee on Stream Flow and Underground Water Records. This Committee presented its report to the annual meeting of Dec. 6, 1929, and was reappointed as another Committee on Stream Flow Gauging, authorised, if invited, to act with and assist a Governmental Department Committee on River Gauging which had been formed as a Sub-Committee to the Standing Advisory Committee on Water, comprising representatives of the Ministries of Health, Agriculture, and Transport. After sittings extending over a year, the Government Committee in the autumn of 1931 suspended or curtailed its investigations, on the ground of economy. It took the view that river gauging was a function of the new Catchment Boards set up by the Ministry of Agriculture and Fisheries under the Land Drainage Act of 1930.

Although not specifically laid down in the Act, it is obvious that a systematic determination of the range of flow in each river basin must be a primary duty of the authorities called into existence for the express purpose of coping with problems of land drainage. It is a fundamental consideration in regard to the utility of river-flow measurements that, if these are to afford reliable guidance, they must be continuous and of prolonged duration. Casual readings are quite inadequate for the preparation of plans of river improvement or control. The Committee of the Institution of Water Engineers, previously referred to, has laid it down that records should be carried on continuously for a period of between five and ten years. Most engineers with river experience will agree that the latter limit is not a day too long, and that, even then, there may be substantial variations in comparison with readings over longer periods. But, since in regard to flood prevention it is the exceptional not less than the average experience which is required, and as abnormal events occur only at long intervals, it is obvious that a much more extended range of gaugings is imperative. The memory of the oldest inhabitant of a district will often furnish instances of inundations so greatly exceeding the normal as to tax the credulity of listeners. Not infrequently, of course, there is an element of exaggeration in these recollections, such as can only be eliminated by careful and painstaking investigation. Ordinary members of Catchment Boards, without special knowledge, can scarcely be expected to appreciate the fundamental importance of continuous and prolonged as well as of precise records. It is the duty of their technical officers to emphasise these essential requirements.

A feature of the case which should not be overlooked is the change which is insensibly being brought about by the increasing extent of impervious surface, especially in urban districts, due to the rapid spread of building operations and road construction. The effect of this is to produce an

appreciable augmentation of the run-off immediately after rainfall.

Some of the forty-six new Catchment Boards, with commendable zeal, have realised their responsibilities, and have appointed special staffs to undertake the work of river survey and gauging in their areas. But this cannot be said, as yet, of the majority. It is to be hoped that lack of co-ordination of effort and uniformity of method may not render the results of variable value. As is evidenced by the earnest discussion in the House of Commons on June 15, and the pressure on the Government to provide financial assistance, flood prevention is a matter of urgent and vital importance to the community as a whole. It would be extremely unfortunate if there should be any avoidable delay in starting the preliminary investigations and any failure to pursue them on the right lines.

The Science of Peace

The Causes of War: Economic, Industrial, Racial, Religious, Scientific and Political. By Sir Arthur Salter, Sir J. Arthur Thomson, G. A. Johnston, Alfred Zimmern, C. F. Andrews, Frederick J. Libby, Henry A. Atkinson, Wickham Steed, and others. Edited by Arthur Porritt. Pp. xxix + 235. (London: Macmillan and Co., Ltd., 1932.) 7*s.* 6*d.* net.

ONE of the most significant and hopeful features in the international situation is the growing extent to which, in the last ten years, attention has been directed not merely to the prevention of war by such efforts as the scaling down of armaments and the provision of alternative methods of settling international disputes, but also to the discovery of the underlying causes of international friction and misunderstandings. This is a positive contribution to the building of a new world order, and is akin to the method of inquiry adopted in all scientific investigations. Too often in the past pacifist and politician alike have been superficial in their methods and inquiry, too eager to get a vexed problem out of the way to care whether the so-called solution or settlement was based on definitely ascertained facts impartially considered, or whether, on the contrary, it did not contain the seeds of a future and more dangerous dispute. The machinery for examining and removing the causes of war which the League of Nations has brought into being, and of which its expert committees form such an admirable example, has probably made the greatest contribution towards the establishment of what may be justly termed a science of peace.

No more authoritative discussion of the causes of war has yet appeared than that contained in the Report of Commission I. of the World Conference for International Peace through Religion. The Commission has called to its aid experts in the fields of economics, industry, racial problems, science, politics, etc., and accordingly we have an analysis of the economic causes of war from Sir Arthur Salter; the cultural causes from Prof. Arthur Zimmern, political causes by Mr. Wickham Steed. Industrial and labour influences are discussed by G. A. Johnston, racial influences by C. F. Andrews; André Siegfried contributes a section on the influence of tariffs, and Moritz Bonn one on migration.

Sir J. Arthur Thomson contributes a rather disappointing chapter on "Science and War" which will, we fear, leave many people wondering on which side scientific workers stand in this matter. It is not sufficient to plead that the blame for the use of knowledge for evil purposes lies in our imperfect human nature and not on the science which has evolved the new weapons of war. Discovery should not be blamed for the abuse of inventions based on it, but the scientific worker will be condemned by world opinion if he does not offer some contribution towards showing the way to the control of the forces his discoveries have released. Our present intolerable situation is due to a wholesale disregard of patent facts, to powerful political prejudices, to a widespread ignorance of social and economic relations in the modern world. We need, as Sir Arthur Thomson admits, a science of society, a true science of economics. It is only as scientific research and scientific methods are patiently and honestly applied in these spheres that we can develop adequate world planning of our industrial and economic resources, greater equilibrium between production and consumption and distribution—the absence of which, as both Sir Arthur Salter and Mr. G. A. Johnston insist, is a potential source of international rivalry and conflict. Similarly impartial scientific inquiry forms the only adequate basis for administration wise enough to eliminate the numerous points of friction which such matters as racial relations, religion, tariffs, migration, or national monopolies still present.

The absence of accurate knowledge in the field of racial relations and the power wielded by ignorance and prejudice are a further danger to peace, and Mr. C. F. Andrews' analysis is supported by a weighty recommendation from the Commission for the voluntary study of race relations as they affect world peace and to promote efforts to remove causes

of racial friction. In particular, an appeal is addressed to the universities to undertake a thoroughly impartial and scientific study of race relations, including anthropological, historical, and biological research, with the view of reaching generally accepted conclusions. This in itself would develop a scientific outlook on the future of the human race in reference to population. This appeal is further supported by a statement from Dr. Rabindranath Tagore, who asserts that this great evil of racial prejudice is only to be overcome by the dissemination of accurate scientific knowledge, and that research in the universities and its interpretation to the world by unimpeachable authority is our most vital need.

Honestly applied in these fields, the scientific method may yet prove mightier than the forces released by the prostitution to destructive purposes of its achievements in the mechanical or physical world during the last half-century. Even in the political sphere, accurate knowledge upon international matters, as Mr. H. Wickham Steed points out, is a prime desideratum, and its accumulation and dissemination as the practice of fact-finding in concert or the technique of conference develops should avail to exorcise the spirit of fear or insecurity and distrust which are foremost among the political causes of war. Certain it is that the dispassionate analysis of the causes of war and their appraisement apart from prejudice in the light of reason afford the only method by which wise preventive measures can be evolved and knowledge regain control. It is at least possible that in this field also the calm, serious spirit of science may prove victorious once more, as in the past it has emancipated mankind from the fetters of superstition and ignorance in the fields of religion and disease.

Laboratory Construction

Laboratories: their Planning and Fittings. By Alan E. Munby. With an Historical Introduction by the late Sir Arthur E. Shipley. Second edition. Pp. xix + 224. (London: G. Bell and Sons, Ltd., 1931.) 30*s.* net.

THE first edition of this work was published in 1926, and the second edition follows on similar lines. The section dealing with the needs of biology and geology has been enlarged by twenty pages, and the last section, consisting of a number of plans of recently built laboratories, has been revised; as before, it contains a number of school laboratories, including those at Clifton, Highgate, and Beaumont, and a number of university laboratories, for both physical and biological sciences. The Los Angeles Normal School laboratories, although included in the school section, would seem more properly to be placed in the university division.

The author in his preface says that "there is still no consensus of opinion among scientists as to what the material equipment in fittings and services should be for a given subject, nor has the author succeeded in raising any general interest in this topic". This is scarcely surprising, for every laboratory is in itself something of an experiment. It falls to the lot of but few people to be concerned with the building of more than one or two laboratories, and these have in general to modify their desires, to bring the cost within the limits of the available resources. Nearly every teacher has suffered in the past from some architectural difficulty in his laboratories, and he is usually mainly concerned to avoid the ills of which he knows, often to produce for himself others unforeseen. There is no common pool of experience. Mr. Munby's book is welcome as an attempt to provide something of the sort. For this reason, one might wish that he had dealt more critically with the design of the laboratories which he has given us. A single example will serve to illustrate this point. In Sir Arthur Shipley's pleasant introduction, a plea is, most rightly, made for more intelligent consideration as to the relative position of the lantern and the screen. For ordinary day-to-day routine work the only place for the lantern is on the lecture bench itself, where the teacher, in whatever institution, may be able almost to operate the lantern with one hand and write on the board with the other. Why is it, therefore, that architects almost always contrive to place a window opposite one end of the lecture bench and a door opposite the other? In the Clifton lecture rooms this error has been avoided, but it would be interesting to know whether, in some of the other lecture rooms shown, the architectural arrangements have operated to prevent proper use being made of the lantern.

In some of the school laboratories shown, part of the space is taken up by desks and part by the usual laboratory furniture. The effect of this seems definitely to be a waste of fifty per cent of the room at one time or another. A critical account of how each laboratory is found in practice to fulfil its aims might help to develop that consensus of opinion which is so slow in developing.

In the body of the work it is at times a little difficult, when the author is dealing with general questions, to know whether he has in mind university or school conditions. The schedule of rooms for definite subjects rather suggests that he holds

the view that school science laboratories should be built on much the same lines as those of the universities, with the omission of some of the specialist rooms. It is difficult to agree with this view, and the recent tendency to build school laboratories on rather an elaborate plan, with expensive fittings, is to be deprecated. One could wish that the author would give us a critical analysis of the essential needs of schools, as distinct from universities, with examples of the way in which these have been successfully met. A few examples as to the difference between schools and universities may be mentioned. The 'top hamper' of the university chemical benches for bottles used in qualitative analysis has no place in schools to-day. Nor are the cupboards under the benches so necessary, except perhaps at the post School Certificate stage. At Rugby, for example, neither drawers nor cupboards are provided in the benches for elementary chemistry. The spaces are there, but they are unenclosed and the contents always open to view. The simplification reduces initial cost, makes supervision simpler and cleaning easier. It is also more than doubtful if in elementary chemical laboratories for schools a special balance room is needed. The conduct of practical work is easier and the costs are reduced if the balances are kept in the laboratory itself.

One of the difficulties under which teachers often labour is that they cannot make full use of the wall space and of the ceiling of their laboratories. Frequently the walls are broken up by the windows, which have been designed more with the view of providing an attractive elevation than with providing what the science teacher needs. Again, they are often plastered and it is sometimes difficult for an active-minded science teacher to fasten to the walls such apparatus as he may from time to time desire to put up. Is there any reason why laboratory walls should be plastered at all? The Cavendish Laboratory stands as an admirable model in its simplicity and effectiveness, and its walls are unplastered. Similarly, more use could be made of the ceiling if suspension beams, such as are suggested in the Board of Education's recent pamphlet on "Secondary School Buildings", were used.

The book contains a useful chapter on laboratory services, but the section dealing with electricity is not adequate to the importance of the subject. The legends under Figs. 64 and 65 have obviously become interchanged.

In some instances the author quotes costs, but these all seem to be higher than is necessary if efficiency only is to be considered. At Beaumont it worked out at 1*s.* 9½*d.* per cubic foot, at Clifton 2*s.*, and at Highgate 2*s.* 1*d.* Special circumstances doubtless account for these, but it would not be difficult to show excellent science buildings costing only 1*s.* 4½*d.* per cubic foot. The cost of fittings must vary with the size of the school and the number of laboratories. At Beaumont it was £2900, at Highgate £5563, and at Clifton £7000. For a school of 400-500 boys, four laboratories and a lecture room, with ancillary rooms, ought with reasonable care to be provided with the mere furniture for something like £1500. In these times of financial stress, those about to build laboratories should not therefore feel unduly despondent if the figures given by the author seem beyond their resources.

Life and Logic

(1) *The Emergence of Life: being a Treatise on Mathematical Philosophy and Symbolic Logic by which a New Theory of Space and Time is Evolved.* By John Butler Burke. Pp. ix + 396. (London: Oxford University Press, 1931.) 30*s.* net.

(2) *The Mystery of Life.* By John Butler Burke. (The Library of New Ideas, No. 5. Pp. 160. (London: Elkin Mathews and Marrot, Ltd., 1931.) 3*s.* 6*d.* net.

WHEN one leans over the infinite, speech appears a rather embarrassing means of conveying to others the volcanic impetus of one's intuitions. Yet, is it not a privilege of the philosopher to attempt a faithful translation of this unique experience? So long as he respects the steady parallelism between facts and their expression, he is allowed to enlist the help of analogy and mathematical symbolism in his errand of spiritual charity. But woe to him if he yields to the charm of his endeavours, and allows himself to be carried by his symbols further than the brutal facts permit. Though he need not fear a violent end as a reward for his exaggerations, he may be liable to suffer the more dreadful penalty of seeing his theories universally dismissed as being castles in the air.

Mr. Burke has taken considerable risks in leaning over the infinite and in trying to record for us the impressions of his vision. During twenty years he has had time to ponder over the maze of difficulties set to human wit by matter, life, and mind; and now he has the courage of proclaiming to the world the solution of the discouraging puzzles invented by the rational genius of the Greeks. Mr. Burke has already made a first attempt, in 1906, when he proposed the view, in his "Origin of Life", that

some kind of living organism is the primordial element, and that inanimate matter is only the result of the decay of living matter. But he was not satisfied himself with the purely experimental side of his theory, and now he comes back to it armed with the compelling weapons of mathematical logic and symbolism. His fundamental method is the application of Leibniz's ideal of a 'universal characteristic', as actualised by Boole's logical algebra, to Hegel's metaphysics; with the result that he obtains a more complex Leibnizianism which suggests also a novel interpretation of Plato's central theory of ideas. The most notable extension of Leibniz's system is that Mr. Burke rejects the principle of pre-established harmony, and explains the interaction between the monads by what he calls 'time-waves' or scintillation of groups of monads in time, which account for the phenomena of living matter, its growth, reproduction, and hereditary transmission.

Mr. Burke emphatically declares that there is not substance but mind. Following Ostwald, who had already destroyed matter for the benefit of energy centred in points in space, he carries these centres of energy further: so they become centres of mind-stuff, or ideas potentially or actually self-conscious, and, in the limit, ideas in that Mind which conceives and animates it all. These self-conscious units or monads are realities apparently independent of each other. The evolution of life and mind from 'so-called' inorganic matter, in the remote past, is then reconciled with the theory that physical and chemical atoms are systems of such monads. Among these 'atoms' Mr. Burke allows a certain amount of natural selection, illustrated by the survival of stable forms or groups, or the sifting of those types which can manifest and propagate in an efficient manner the characteristic properties of life. The vital principle in organic and inorganic matter is then to be sought in this variation in the atoms of the organism.

The manner in which such variation may arise and be followed up—that is, the evolution of the nebular and spiral atoms in the various stages of condensation, from the primordial substance of mind-stuff to the structure of highly developed mind—is explained in great detail in "The Emergence of Life", after an interesting discussion of the necessary logical and methodological prolegomena, such as algebraic analysis, existential propositions, certainty and probability, induction and analogy. "The Mystery of Life" gives an interesting summary of these views, with some additional comments on their philosophical bearings.

The question whether Mr. Burke's stimulating views carry with them a universal conviction will have to be left open. There is no doubt, however, that they deserve a careful study, in so far as they indicate a possible method of approach to the problems of matter, life, and mind. Though he makes a legitimate use of mathematics and logical symbolism, his analogies seem to be sometimes far-fetched, as, for example, when he suggests that the conjunction of two imaginary notions may yield a real idea, as is the case with two complex numbers. But perhaps this difficulty is due to the fact that the metaphysical interpretation of the complex numbers and their operations is not yet definitely settled. Again, one might be tempted to dispute the truth of Mr. Burke's initial principle that the primordial substance accounts by itself for the existence and evolution of matter, organic and inorganic. Even a matter of years could not show us whether this dogmatic assertion is an arbitrary assumption or not. But here the wider ground of speculative philosophy is safer for Mr. Burke than that of natural philosophy with its restrictions in space and time; for, as he says himself, if life on earth will last for yet a thousand million years, it is not unlikely that man may yet realise the purpose of his existence, while memory holds a seat in this distracted globe. We may outlive our present knowledge in beauty, in growth, and in strength, in worlds more real though now unknown, but not unknowable in the æons that are yet to come. T. GREENWOOD.

Agriculture and National Prosperity

Fertilizers and Food Production on Arable and Grass Land. By Sir Frederick Keeble. Pp. xi + 196. (London: Oxford University Press, 1932.) 5*s*. net.

THE nation is at least alive to the deplorable plight of the agricultural industry in Great Britain. This awareness is undoubtedly penetrating deeply, and there is a growing desire to be informed as to the facts—and the facts of agriculture are singularly intricate and involved. The hard truth, however, remains, that a sound agricultural policy can only be built with bricks and mortar that have themselves been constructed by capable workmen possessed of the necessary knowledge.

To marshal an immense amount of information fundamental to a proper understanding of the agricultural potentialities of Great Britain, and to weld the evidence from innumerable experiments and extensive trials into a concrete and highly sug-

gestive story of less than 200 pages, is indeed a signal achievement. This is what Sir Frederick Keeble has accomplished in the little book before us. It is true that Sir Frederick is here only concerned with the production aspect of the general problem. What does the country produce ? And what could the country produce ? These are the questions which in effect Sir Frederick has set himself to answer. In the last resort, however, policy must be based on sound economic production, and to-day sound economic production must to a very large degree be determined by the skill with which artificial fertilisers are employed.

There is no gainsaying that the farmers of Great Britain as a whole are not making a sufficiently abundant or a sufficiently well-informed use of fertilisers. Thus, as Sir Frederick pointedly remarks, although the acreage under pasturage has been considerably increased during the past sixty years, the grasslands of the country are carrying few if any more live stock. Indeed, the picture which Sir Frederick is compelled to paint in the opening chapters of his book is a sombre one: thousands upon thousands of acres needing drainage, scores upon scores of fields without facilities for watering, and whole districts in need of lime. It is, however, when the results of experiments and records are considered that we are made to realise that the present gloom and depression is by no means inexorable. In dealing with experimental evidence, Sir Frederick Keeble has in the main confined himself to the results obtained from the extensive investigations undertaken at the Jealott's Hill Agricultural Research Station and from the trials conducted in the counties and overseas under the auspices of the research staff of the Station.

All this research is of itself of great intrinsic importance, and has an added value not only because it has been unusually far-flung, but also because it has been conducted with absolutely definite economic ends in view, and the whole undertaking has been in no wise hindered by undue adherence to orthodox opinions. It is stimulating and suggestive to find the problem of the soil and of fertility being dealt with essentially from the biological point of view. "Crop, soil and soil micro-organisms", Sir Frederick insists, "must need be investigated simultaneously," and with characteristic vision he adds, "a great task fraught with great issues for the welfare of mankind."

As is only to be expected in the case of a book dealing with such a wide range of issues and with the interpretation to be put on so large a number of inter-related phenomena, there are points of detail concerning which we might join issue with the author; points which for the most part, however, are still under investigation both at Jealott's Hill and elsewhere. It is probable, for example, that less than justice is done to ordinary moderate grassland which is reasonably well managed and which has a high clover content. Thus in Chart III., on p. 43, comparison is made between the "oat crop", "ordinary grass cut for hay", and "intensive pasture grass". Certain types of clovery pasture, although more or less extensively managed, would of course stand comparison with the "intensive" grass altogether better than would "ordinary grass cut for hay". The virtues of clovery grass are not, however, ignored, and the suggestions made for the rotational (in the annual sense) cropping of grassland (pp. 121-124) are of the highest importance and of far-reaching significance.

The value of the book is much enhanced by the excellent charts, abundant and well-arranged tables, and carefully prepared appendixes.

Short Reviews

Fundamental Experiments in Chemistry: a Handbook for Teachers and Students; Lecture and Class Experiments to establish Chemical Laws and to confirm the Atomic Theory. By E. D. Goddard. Pp. xii + 147. (London: Ginn and Co., Ltd., n.d.) 3*s*. 6*d*.

THIS little handbook, evidently the outcome of long experience in teaching young students, is primarily intended for science masters in secondary schools. It includes a well-selected and well-arranged collection of lecture and class experiments designed to establish the laws of chemistry and to confirm the atomic theory. By actually doing some of these and having others demonstrated to them, students should obtain a clearer conception of the fundamentals of chemistry than they could derive from a mere recitation of the evidence adduced by the pioneers and the more recent advances by later research workers.

The author gives a description of the experiments and methods he has found successful in presenting such matters as the density of gases and the volume composition of water, hydrogen chloride, ammonia, the oxides of carbon, nitrous oxide, and ozone to classes of boys. Appended to each experiment is a series of notes giving special hints and indicating necessary precautions or variations that are admissible. Another valuable feature of the book is that the results actually obtained by the students themselves are used as examples to illustrate the experiments and the working out of the results. Like the author, the reviewer has found it a good plan to summarise all the results of the students, since, at the conclusion, they are invited to indicate which results should be omitted when the average result

is being found. It is remarkable that the average result for the whole class is usually surprisingly near to the correct one.

Science masters and others will find Mr. Goddard's book useful, if only on account of the number of interesting little points and suggestions he makes in connexion with each experiment. J. G. F. D.

Handbuch der physikalischen und technischen Mechanik. Herausgegeben von Prof. Dr. F. Auerbach und Prof. Dr. W. Hort. Band 1: *Technische und physikalische Mechanik starrer Systeme,* Teil 1. Lieferung 1. Pp. ix + 306. Lieferung 2. Pp. viii + 307-694. Lieferung 3. Pp. 695-787 + xviii. Band 1, vollständig, 80 gold marks. Band 2: *Technische und physikalische Mechanik starrer Systeme,* Teil 2. Lieferung 1. Pp. viii + 404. Lieferung 2. Pp. xiv + 405-673. Band 2, vollständig, 75 gold marks. (Leipzig: Johann Ambrosius Barth, 1927–1930.)

DURING the years 1890 to 1896 Winkelmann published a famous handbook on physics, which reappeared in a new edition in the years 1901 to 1909. When, about six years ago, a third edition was called for, the growth of material to be treated led to the division of the single handbook into a series of handbooks, each dealing with different domains, under separate editors. Among their subjects are electricity and magnetism, physical optics, and mechanics (physical and technical). The last of these, which is the subject of this brief notice, comprises seven volumes, some of them divided into parts separately published (these cannot be separately purchased, each volume being sold as a whole). Some part of each volume has appeared, and some volumes, but not all, are complete. The work is remarkable in its scope, and is well printed and illustrated. Probably few individual teachers or students could afford to possess a copy of so large a work, which is necessarily expensive, but in scientific libraries, whether academic or industrial, it deserves a place. Its great merit is that it brings together, in an easily accessible and assimilable form, a large body of scattered knowledge on mechanics, together with references to sources of fuller information. The first two volumes deal with the general principles and main results in kinematics, dynamics and statics, and mechanism, and conclude with an interesting account of physiological (including human) mechanics and mechanism.

The Mysterious Universe. By Sir James Jeans. Second edition. Pp. ix + 142 + 2 plates. (Cambridge: At the University Press, 1931.) 2*s*. net.

IN the second edition of this well-known book, the author explains that he has found with regret that certain passages in the original book were liable to be misunderstood, misinterpreted, and even misquoted, in various unexpected ways. He has expunged some of these passages and re-written or amplified others. Here and there new paragraphs, occasionally even whole passages, have been added in the hope of making the argument clearer. The main line of thought, however, is unchanged, and needs no comment. The opportunity has also been taken of correcting certain misprints and errors in the first edition. It is a pity that this was not carried out more thoroughly. We still have, for example, the ambiguous "this" on p. 38, line 11; the miscalculation on p. 84; the singular noun and plural verb at the top of p. 134; and the statement (p. 49) that Maxwell had "shewn" (instead of "predicted") and Lebedew had "measured" (instead of "observed") the pressure of radiation. One of the newly introduced paragraphs, in fact, contains the misstatement (p. 119) that Kepler believed in the truth of his "five solids" law "for one brief moment". Criticism of details to the neglect of the whole is admittedly reprehensible, but insufficient care in verifying details, especially in a second edition, is nevertheless to be regretted. The paper and printing of the new edition are in no way inferior to those of the old, despite the reduction in price.

Dimensional Analysis. By Prof. P. W. Bridgman. Revised edition. Pp. vi + 113. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1931.) 24*s*. net.

THE second edition of Prof. Bridgman's well-known book differs very little from the first. A few minor errors are corrected, and references are given to the writings of certain other authors that have appeared in the interval. Though these are strongly critical of Prof. Bridgman's doctrines, he sees no reason to change his opinions; he prefers, therefore, not to enter into controversy, but to leave his readers to judge between him and his critics. This procedure is entirely creditable to Prof. Bridgman, and certainly preferable to an attempt to expound views with which he has no sympathy. But the whole position is not creditable to science. The differences that divide Prof. Bridgman from his critics are not matters of opinion; they concern the validity of certain quite simple logical arguments; one side in the dispute must be definitely right and the other definitely wrong. Let us hope that the appearance of this reprint will encourage impartial examination of the controversy and lead to the final establishment of the truth. N. R. C.

Quanta et chimie. Par Prof. Arthur Haas. Traduit de l'allemand par Jeanne Perrenot et F. Esclangon. Pp. v + 69. (Paris: Gauthier-Villars et Cie, 1931.) 15 francs.

THE scope of this little work, based on four lectures, is, as explained in the author's preface, to present, as simply and shortly as possible, quantum physical theory having an interest to chemists, and avoiding any use of mathematics. As the limitations imposed by these conditions indicate, the book is a résumé of the position (in 1929), popular only to the extent of being written for the non-specialising scientific worker. The four chapters deal with the arithmetic of chemical periodicity, the quantum theory of valency and chemical forces, electron grouping and the periodic system, and the quantum problem of molecular and nuclear structure. An English version has appeared under the title of "Quantum Chemistry". N. M. B.

World Structure and the Expansion of the Universe*

By Prof. E. A. MILNE, F.R.S.

THE most distant nebulæ appear to be receding from us, and the velocity of recession is proportional to the distance. The most commonly accepted explanation of this phenomenon is that due to Friedman and Lemaître. The principle of their explanation is that it is possible to describe the observed facts by assigning fixed co-ordinates to a distant nebula in a curved space-time in which the metric involves the time t. The spatial interval-distance between the nebula and the observer is then a function of t. The difficulties of this explanation are (1) that it involves the existence of 'cosmic time' and restores the distinction between time and space abolished by Minkowski; (2) that it has been impossible to explain why 'space' is expanding and not contracting. This theory is a development of the remarkable pioneer theories of Einstein and de Sitter, which contemplated static metrics for space-time. De Sitter's world, it is true, placed time on the same footing as space, but Einstein's cylindrical world introduced "cosmic time". More recently (*Proc. Nat. Acad. Sci.*, **18**, 213; 1932), Einstein and de Sitter have concluded that at the present moment it is impossible to determine the algebraic sign of the curvature of 'space', and that the facts of observation can be described by assigning fixed co-ordinates to a distant nebula in a quasi-Euclidean space expanding with the time.

A much simpler explanation of the facts may be obtained as follows. The explanation abandons the curvature of space and the notion of expanding space, and regards the observed motions of distant nebulæ as their actual motions in Euclidean space.

Consider a spherical region of Euclidean space, occupied at time $t=0$ by a uniform spatial distribution of moving particles, moving in random directions with velocities u, v, w, distributed according to a law $f(u, v, w)\, du\, dv\, dw$. The density is supposed to be so small that collisions do not occur and forces of interaction are supposed negligible. Outside the sphere (say of radius r_0) let space be empty. Then the *outward* moving particles will move into the empty space outside and the faster particles will gain on the slower. At any time t the fastest moving particles will form an expanding spherical frontier, followed by the next fastest, and so on. The *inward* moving particles will traverse the sphere of radius r_0, emerge at the other side, and then move outwards. Thus at any sufficiently large time t all the particles moving with a given speed V will be found between the spheres of radii $Vt-r_0$ and $Vt+r_0$. We see at once that after the lapse of sufficient time, all the distant particles will have velocities of recession; and the mean velocity of recession at any distant point will be ultimately proportional to the distance, the constant of proportionality being simply $1/t$. The interior of the original sphere, and indeed all space inside the distant moving portion, remain occupied throughout. For example, near the centre of the original sphere, after a long time t only slow-moving particles will be found, namely, those which started inwards from the original frontier with sufficiently small velocities. The density everywhere decreases with the time, and the particles sort themselves out in velocity, the sorting becoming more perfect the larger the velocity.

Clearly the restriction to an initially uniformly occupied sphere is unnecessary. Any initial density distribution which decreases sufficiently rapidly with distance will give rise to the same effect. This is true even if the initial distribution fills infinite space. The only difference is that *every* small element of volume always contains a few slow-moving particles, even after a long time; but the sorting goes on. The essential aspect of the situation is that we are dealing with an unenclosed system.

The above explanation is applicable at once to the system of nebulæ. The fastest moving ones will have velocities exceeding the velocity of escape against gravity, and will ultimately pursue curves indistinguishable from their linear asymptotes.

This common-sense explanation has many advantages in addition to that of rendering unnecessary the introduction of a curved 'space' and a non-static metric. It shows at once that the system is necessarily an expanding system after a sufficiently long time. If at any instant all the velocities are imagined to be reversed in direction, the system appears to contract to its configuration at time $t=0$ and then expands again. Moreover, if at time $t=0$ all the velocities are reversed, the system still expands. The instant $t=0$ affords a natural origin of time for the observer recording the distribution-laws. From this instant evolution proceeds in an inevitable direction, namely, in the direction of expansion. We may say that creation and uni-directional evolution are brought into a single mathematical scheme.

It is quite unnecessary, however, to introduce a 'cosmic time'. Let an observer count the particles with velocities inside the range u to $u+du$, v to $v+dv$, w to $w+dw$, and arrive at the law $f(u, v, w)\, du\, dv\, dw$. Let a second observer, moving with uniform velocity V_0 with respect to the first, make a similar enumeration, and suppose he arrives at the law $f_1(u, v, w)\, du\, dv\, dw$. We may inquire what must be the actual distribution-law in any frame so that $f\equiv f_1$, that is, so that the velocity-pictures of the universe recorded by the two observers are identical. Neglecting the curvatures

* Synopsis of a paper read at a colloquium at Wadham College, Oxford, on June 7, 1932.

of the paths, we find that the distribution-law must be

$$\frac{B\, c\, du\, dv\, dw}{(c^2 - u^2 - v^2 - w^2)^2}$$

where B is a pure number and c is the velocity of light. This permits a continuous distribution of velocities up to c. Since actual recession speeds have been recorded up to one-fifteenth of that of light (19,700 km./sec., see Humason, *Mt. Wilson Contributions*, No. 426, 1931), and since still higher velocities may be expected, there seems nothing fantastic about this distribution-law.

Suppose now two observers start at the centre $x=0$, $y=0$, $z=0$ of the initial spherically symmetrical distribution at time $t=0$, with relative velocity V_0 with respect to one another. We may inquire what must be the spatial distribution of particles such that the universe will for ever appear the same to each observer. This requires a more complicated analysis, for the two observers will disagree as to what is meant by simultaneity. To solve this problem it is necessary to introduce the concept of the intensity I of world-lines at a point in time-space in a given direction. This is defined as the number of world-lines per unit solid angle in 4-space per unit 3-space cross section normal to the direction of the world lines. The conditions that any proposed function $I = F(x, y, z, u, v, w, t)$ shall represent a concourse of permanent objects are that (1) F shall be invariant for a Lorentz transformation, (2) F shall be constant along a world-line; the second condition is readily shown to be equivalent to the satisfaction of Boltzmann's equation in gas-kinetic theory. When F is determined and we return to the co-ordinates x, y, z, t of any particular observer measured from the natural origin of time-space, the distribution law is found to be

$$\frac{c^2 A\, du\, dv\, dw\, dx\, dy\, dz}{(c^2 - \Sigma u^2)[(c^2t - \Sigma ux)^2 - (c^2t^2 - \Sigma x^2)(c^2 - \Sigma u^2)]^{\frac{3}{2}}}$$

which may also be written in the form

$$\frac{c^2 A\, du\, dv\, dw\, dx\, dy\, dz}{(c^2 - \Sigma u^2)[c^2\Sigma(x - ut)^2 - \Sigma\{v(z - wt) - w(y - vt)\}^2]^{\frac{3}{2}}}$$

This shows at once that for given $x^2 + y^2 + z^2$ and given $u^2 + v^2 + w^2$, the density is a maximum (for sufficiently large t) when $u : v : w = x : y : z$, that is, it gives the recession predominance. It also gives the velocity-distance correlation for t large. Integrated over the complete spatial solid-angle for 3-space it gives for time $t=0$ the distribution-law

$$\frac{4\pi c\, A\, du\, dv\, dw}{(c^2 - \Sigma u^2)^2} \cdot \frac{dr}{r}$$

showing that the density-distribution at any time t may be derived as the natural expansion of an initial distribution * with a density law $\rho \propto 1/r^3$. This of course gives a congestion of matter at the origin at time $t=0$, and expanding spheres of singularities at any other time. This in turn shows that it is necessary to introduce gravitation and so curvature of world-lines as a second approximation. But the density law $\rho \propto 1/r^3$ gives a gravitational potential tending to a constant at large distances, and so preserves the analysis as representing the uniform rectilinear motions at great distances. Presumably a Gaussian metric is required for the vicinity of the space-time origin, but it tends to the Galileian form at great distances.

According to these very elementary considerations, which only involve the principles of the special theory of relativity, the continuum of time-space is occupied at large distances from the natural space-time origin by a hyper-complex of world-lines having spherical symmetry about the space-time origin. There is no such thing as cosmic time. But at each point of space-time there is a unique direction in which the space-time origin lies. Every observer sees the same velocity distribution at great distances. Every observer can regard himself as the centre of the universe by choosing his time axis so as to point away from the time-space origin—in other words, by choosing the motion of his frame of reference so that it is at rest with respect to the vector average of the motions in his immediate neighbourhood. The world is then perfectly ego-centric at all points, and the moving picture of the world as made by any one observer is identical with that made by any other observer.

The principle of relativity in its original form asserted that all frames of reference are equivalent for the description of the *laws* of Nature. The foregoing ideas rest on an extension of the principle to the assertion that the world itself, when local irregularities are disregarded, must appear to have the same structure to all observers; in other words, the principle of relativity is extended from the *laws* of Nature to the *phenomena* occurring in Nature.

We cannot observe space. We observe point-events. But we can recognise the continued existence of material objects, and hence we can arrange these observed point-events in world-lines. It seems best to avoid the phrase 'the structure of space' or of 'space-time', and consider simply the structure of the hyper-complex of world-lines which can be reconstructed from our observations. The preceding analysis discusses the simplest ideal system of world-lines that is compatible with the observed permanence of material objects and satisfies the extended principle of relativity. It is not difficult to generalise the analysis so as to describe a hyper-complex of curved world-lines and to connect the distribution of intensity with the distribution of curvature, and thus to make some progress towards the introduction of gravitation even inside the limits of Galileian space-time. But these developments are deferred to another occasion. I conclude by emphasising the very simple explanation of the expansion of the universe of material objects obtained by examining the kinematics of an unenclosed system with central condensation.

* For $t=0$, the last formula gives the distribution *between* the radii r and $r+dr$. But at $t=0$, at any given *point* r, the velocities are predominantly tangential.

Three Arctic Expeditions in 1931

IN the summer of 1931, three expeditions using very different equipment visited adjacent regions of the arctic, and Prof. H. U. Sverdrup has summarised the preliminary results obtained and compared the usefulness and prospects of the different methods employed.* The Swedish-Norwegian party under the leadership of Prof. H. W:son Ahlmann relied upon the old proved technique and carried out oceanographical work from the *Quest* in the neighbourhood of Franz Josef Land and Spitsbergen (North-East Land) together with dog and sledge journeys across North-East Land, which was shown not to be covered with a continuous ice sheet as formerly believed, but to be divided into two ice areas by a broad ice-free valley. Large geological and botanical collections were made, and the study of these and of the meteorological and oceanographical observations is proceeding.

The other expeditions with submarine and airship were financed by the Press, and for this reason and on account of the novel means employed, they received wide publicity. An American Press magnate who was interested in Wilkins's submarine (*Nautilus*) project had offered to finance the Zeppelin flight on the understanding that the air-ship should attempt to establish contact with the submarine near the north pole, but when the *Nautilus* was delayed by an unlucky Atlantic crossing, this plan had to be abandoned and the support for the flight was not forthcoming. Fortunately the commander, Dr. Eckener, was able to come to a favourable understanding with the German Press, and although the original plans developed by Nansen of a flight across the pole could not be entertained, a cruise to Franz Josef Land and to Nicholas II. Land off northern Siberia was successfully accomplished.

The Zeppelin trip from Leningrad only occupied four days. At Franz Josef Land the airship descended to the water and exchanged mails with the Russian ice-breaker *Malgyin*, and this—the first 'landing' to be made without ground parties—demonstrated the usefulness of the ship as a transport vessel to uninhabited regions. One of the unknown dangers of the expedition was the possibility that ice would be precipitated from the clouds on to the great envelope of the airship and force it down, but this was not realised, because throughout the cruise the temperature of the air passed through was above 0° C., being higher at 1000 m. than at the earth's surface. This temperature inversion, well known to exist in winter, Prof. Sverdrup thinks, may not always obtain in summer, and he anticipates different conditions in the Atlantic quadrant of the polar area from those over the Siberian and Alaskan quadrants, and issues a warning against generalising from this limited experience.

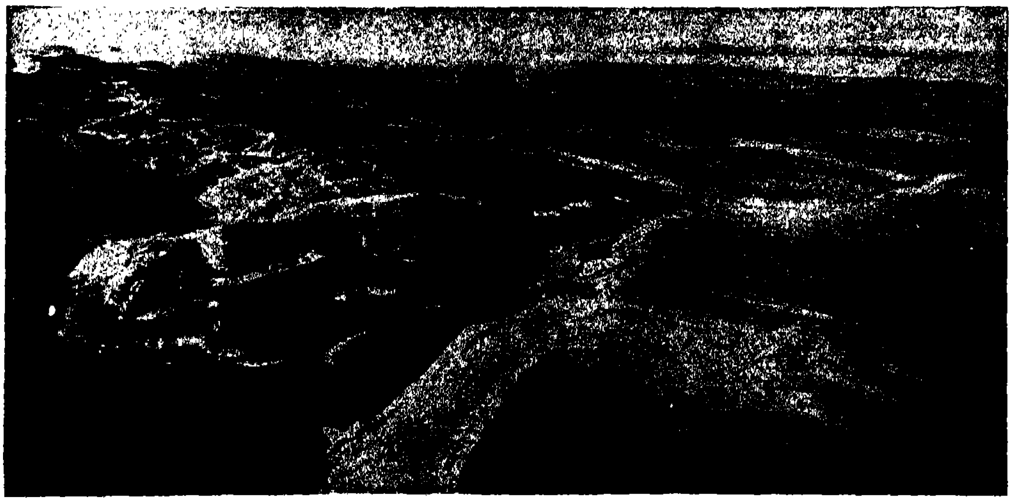

FIG. 1.—Panorama of the Taimyr Peninsula. The shadow of the *Graf Zeppelin* is seen near the middle of the right half of the picture.

For the first time, radio *ballons-sondes* devised by the Russian meteorologist Moltschanof were used to obtain observations of the upper atmosphere. These balloons are equipped with small radio-transmitters sending out signals from which temperature and humidity values are obtained for different altitudes, thus furnishing instantaneous records in regions where there is little hope of the recovery of instruments. Four balloons were dispatched, of which three reached an altitude of more than 16 km., and it was found that at about lat. 80° the temperature of the stratosphere (with its base at 10·4 km.) was −50° C. In summer the average height of the stratosphere in Europe is 11 km. The *Maud* expedition in the spring months obtained a value of 8·5 km. north of Siberia, and Prof. Sverdrup suggests that whereas in general the

* *Nature*, 1932, p. 86.

height of the stratosphere falls off from the equator to the pole, its minimum altitude, which may be styled the meteorological north pole, does not coincide with the geographical pole but lies between it and Siberia and Alaska. Photographs were taken which will be of assistance in improving the maps of Novaya Zemlya and Franz Josef Land, and it was discovered that Nicholas II. Land is divided into two by a broad strait which has now been mapped on the ground by the Russian geologist, N. N. Ourvantzev.

The good fortune which followed the Ahlmann and Eckener expeditions was denied to Wilkins's submarine venture, in which Prof. Sverdrup himself took part. On reaching the pack ice north of Spitsbergen, it was found impossible to dive, on account of the loss of the vertical rudder: the main project—to test the feasibility of navigation under the ice—was unfulfilled, and instead of a submarine the explorers found themselves in a ship very unfitted for ice work. Nevertheless, a large number of echo soundings and a series of gravity measurements were made, oceanographic stations established, and bottom samples brought up from depths down to 3500 m. From the character of the deeper water, further evidence was obtained in support of Nansen's deduction that the submarine ridge trending northwest from Spitsbergen descends to 1500 m. between Spitsbergen and Greenland.

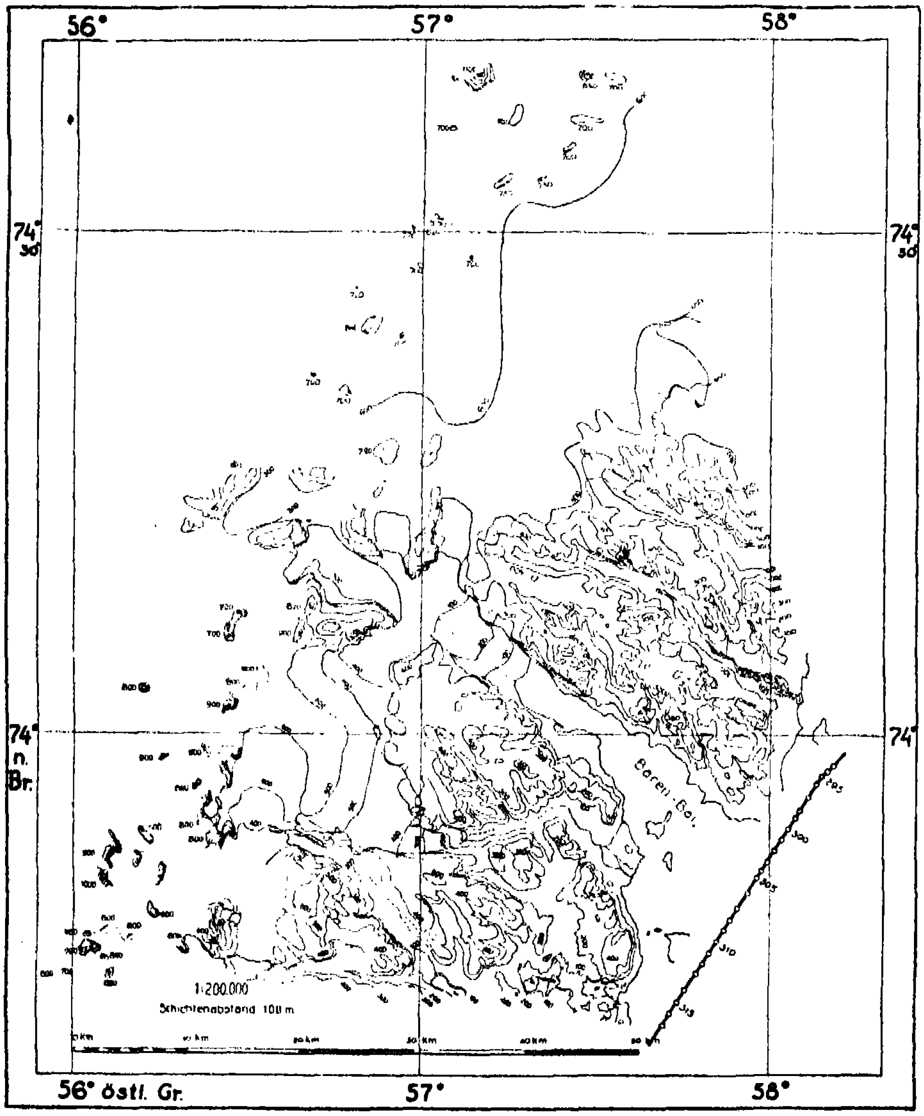

FIG. 2.—Map of part of south-east Novaya Zemlya made from the *Graf Zeppelin* survey.

The conclusion is reached that the old polar technique still maintains its superiority, for there is no doubt that when the results are worked out, those of the Ahlmann expedition will prove the richest; but the airship has definitely 'arrived' and one can confidently anticipate further developments of its usefulness in this field of exploration. Judgment cannot yet be passed upon the submarine—a better boat than the *Nautilus* must be available—but Prof. Sverdrup is of the opinion that "the U-boat will prove the ideal means of travel across the polar sea in summer, and that with the U-boat it will be possible to obtain full knowledge of the oceanography of the Arctic".

A description of the photographic apparatus carried by the *Graf Zeppelin* and an account of the methods employed in the preparation and orientation of maps based upon the photographs has been given by Otto V. Gruber,* from whose paper the accompanying illustrations are produced by courtesy of Messrs. Carl Zeiss, Ltd. The general procedure is similar to that which is adopted in aeroplane photogrammetric surveys. One of the addi-

* "Über die photogrammetrische Ausrüstung des *Graf Zeppelin* auf der Arktisfahrt 1931 und die Auswertungsmethoden für das gewonnene photogrammetrische Beobachtungsmaterial." *Bildmessung und Luftbildwesen*, No. 4, 1931. (Liebenwerda, Sachsen: R. Reiss G.m.b.H.)

tional advantages of operating from an airship is that under favourable conditions the shadow of the vessel appears on the photographs (Fig. 1), thus providing a control over the orientation and scale of the map.

As an example of what can be accomplished by airship survey, we reproduce the map (Fig. 2) of a part of south-eastern Novaya Zemlya showing the coastal region and the inland ice. The map is on the scale of 1/200,000 with contours at 100 m. intervals, and the errors in scale and height are stated not to exceed 10 per cent—probably not 5 per cent. The latitude and longitude may be as much as 1° out, and to correct this it would be necessary to determine by astronomical methods on the ground the true position of some point identifiable on the photographs, or to extend these to include some known point.

L. H.

Obituary

SIR DORABJI TATA

IN the memorial to his wife which he settled shortly before his death on June 4, Sir Dorabji Tata described himself as "The Last of his House". That is painfully true; with his passing an end comes to a family which played a great part in the intellectual and industrial renaissance of India.

Dorab Tata's rôle in this was that of the executor rather than the creator. The pioneering was done by his father, Jamsetji Tata. Having founded the family fortune firmly by establishing a prosperous cotton-spinning business, he bent his adventurous talents to three great enterprises—the establishment of an Institute of Science to prepare Indians for the direction of modern large-scale industries; the construction of iron and steel works as an essential link in the economic cycle; and the harnessing of the prolific rainfall of the Western Ghats to electric power stations to relieve the dependence of Bombay on far-distant coal-fields. But he died before any had reached the final stage; on the contrary, the freedom with which he spent on the development work rather seriously 'locked up' the family resources.

At this stage Dorab Tata took control of the business. With the active sympathy of his brother, the late Sir Ratan Tata, he set himself the filial task of completing his father's work. After many discouragements, thanks to the co-operation of Lord Curzon and the Government of India, the Institute of Science was established at Bangalore. Thence a steady stream of well-trained Indians has passed into the service of Indian industry. Unfortunately, Bangalore, though admirably suited climatically, is so far from the industrial centres that its activities do not command the interest and support which they should receive; but the work goes on.

The history of the Iron and Steel Works at Jamshedpur reads like a romance. The dogged tenacity with which Dorab Tata and his expert advisers searched the Central Provinces for ore surprised even his closest friends; for he was born to easy days. When their patience was rewarded by the discovery of a hill of iron ore of the finest quality at Gurumashini, the quest for capital was as baffling as that for "The Golden Girl". British enterprise does not come well out of the test. Though the existence of the requisite materials was established beyond doubt, and the home market justified the establishment of large-scale manufacture, British capital was timid and exacting, and no progress was possible. Fortunately, on the crest of the *swadeshi* wave India took this opportunity to itself and subscribed the money with an ease which surprised everyone; but equipment and operation were American and German when the British industrialist and financier missed their opportunity.

The same wave of constructive enthusiasm launched the hydro-electric works with Indian capital. Though the three associated companies—the Tata Hydro-Electric, the Andhra Valley, and the Tata Power—are capable of delivering electrical energy in Bombay far beyond the capacity for absorption, the heavy capital cost, especially during construction, has not given industry the cheap power which it demanded.

Here Dorab Tata himself would have been glad to call a halt. He was a rather reluctant partner in the manifold activities into which his house launched, and which brought anxious days when the post-War reaction set in. But he rose to the occasion and placed his private fortune behind the Iron and Steel Company when the dark days came, and, backed by the indomitable courage of his cousin, the late Mr. R. D. Tata, weathered the storm.

The qualities which Dorab Tata brought to this work were those of tenacity rather than of originating power, and a fine financial integrity. He was always willing to pay for brains, even extravagantly if he got the best. His monument is the Institute of Science, with its encouragement of pure industrial research, and the iron and steel industry, with linked enterprises, which has created a hive of industry in the virgin forests of Chota Nagpur. The contribution of his house to the renaissance of India is the recognition of the indispensability of science to modern industry, and the patriotic vision which looked beyond 'penny-in-the-slot' enterprise to the foundation of key industries, which though expensive are essential to the economic cycle.

STANLEY REED.

DR. B. A. BEHREND

DR. BERNARD ARTHUR BEHREND died on March 25 this year, in Wellesley Hills, Mass., at fifty-six years of age; and a correspondent who knew him intimately has sent us the following appreciation of his life and work, to supplement the many memoirs which have appeared in our engineering contemporaries.

Behrend was a man of the widest interests, and

made his mark and his influence felt wherever those interests drew him. As an electrical engineer his far-sighted and vigorous pioneer work made him known as in the first rank in Europe and America. His early recognition of the genius of C. E. L. Brown (Brown, Boveri and Co.), as indicated, for example, in his series of articles in 1901–2 on "The Debt of Electrical Engineering to C. E. L. Brown", illustrated his intuitive engineering faculty for seizing and advancing upon the best features of current practice, when not actually initiating them. He had been very appreciative of encouragement in his early career from such men as Gisbert Kapp and André Blondel, and this made him ever watchful to encourage and give such praise as might fairly be given to his young assistants; indeed, many of them were of his own age or older, since he had achieved much, and had established himself, while yet quite a young man.

Behrend's literary and philosophical leanings resulted in his home being built around his library, whether in Cincinnati, Milwaukee, Pittsburgh, or Boston; while a strong antiquarian bent for early colonial furniture turned him into a collector of note. He had a wide knowledge of general scientific writings, and perhaps no man held a higher place in his esteem than Thomas Henry Huxley; he made a pilgrimage to Mrs. Huxley at 'Hodeslea' in 1910. Charles Darwin, Andrew D. White, John Perry, were intimate book acquaintances. But it was not merely such men, their fame already established, whom he held in honour, for he often showed himself an alert and aggressive champion of interests which would otherwise have continued in undeserved neglect, as witness his well-known successful activities on behalf of Oliver Heaviside.

Behrend was the recipient of many honours, and a year before his death the honorary degree of doctor of engineering was conferred upon him by Darmstadt. As an American citizen he was loyal and patriotic, but believed that the time was past for intense nationalistic feeling in men of affairs. Of comparatively small stature and frail health but intense vitality, Behrend was an antagonist indeed to be reckoned with when his indignation was stirred, but was a man of large generosity, both in sentiment and practically, to a host of men who long will gratefully remember him.

As publicity has been given to the fact that Dr. Behrend took his own life, it should be recorded here that he was convinced that he was suffering from an incurable cancer. His last years were enriched by his marriage in 1926 to Margaret Plumer Chase, of whose devotion during the long illness preceding his death he wrote in eloquent terms.

WE regret to announce the following deaths:

Prof. Bernhard Bang, formerly veterinary adviser to the Government of Denmark and professor of internal diseases at the Royal Veterinary College, Copenhagen, known for his work on tuberculosis, on June 22, aged eighty-four years.

M. Albert Durand de Grossouvre, *correspondant* for the Section of Mineralogy of the Academy of Sciences, Paris, aged eighty-two years.

Prof. Aimé Sneider, formerly professor of zoology in the University of Poitiers, known for his work on the parasitic Protozoa, on March 27, aged eighty-seven years.

Prof. J. W. Young, professor of mathematics in Dartmouth College, Hanover, New Hampshire, author of numerous works on the fundamental concepts of algebra and geometry, on Feb. 17, aged fifty-two years.

News and Views

Early Man in Java

ON p. 20 of this issue of NATURE there appears a letter on the recently found Ngandong skull, from Prof. E. Dubois, whose discovery of *Pithecanthropus erectus* and close association with palæontological research in Java entitle him to speak with authority on the question of early man in south-east Asia. After careful study of Dr. Oppenoorth's paper, he has arrived at the conclusion that Ngandong man and Wadjak man are one identical type. This view carries with it certain implications, to which Prof. Dubois briefly refers, of no little importance in the study of the evolution of human types. Wadjak man is represented by two skulls discovered in the terraces of a dried-up freshwater lake near the southern coast of Java, one in 1889 and the second by Prof. Dubois himself in the following year, and brought back by him from Java in 1895, but not described until 1921. These skulls have been regarded as ancestral to the Australian; but it has been pointed out, notably by Sir Arthur Keith, that Wadjak man, so far as described, presents certain points of resemblance to Rhodesian man—for example, in the relatively enormous size of the palates, of which the area is identical. Prof. Dubois regards one of the Wadjak skulls, which in this respect differ *inter se*, as approaching the Ngandong skull in the shape of the occiput and other points; while Oppenoorth says of the latter that it resembles the Rhodesian skull, especially in the shape of the occipital bone, while the back of the skull "bears a resemblance to the Australian race". Thus with the Talgai skull of Queensland—probably pleistocene, and probably a relative of the Wadjak man, but still more closely related to the modern Australian—the newly discovered Javan skull apparently helps to link up a group of skulls, reaching out experimentally, if not in a direct line of ascent, to the modern Australian type.

Magic and Medicine Men

ALTHOUGH there is a great similarity in the supernormal performances of witches and medicine men wherever recorded, the selection of certain alleged powers of West African magicians as the subject of a challenge by the local Council of the Christian Missions (see NATURE, June 11, p. 862) adds interest to the

practices of certain members of the Bear gens of the Fox Indians of Oklahoma, to which reference is made in a recent publication of the Bureau of American Ethnology ("Notes on the Fox Wâpanowiweni": by Truman Michelson, *Bull.* 105). The bear, it may be mentioned, in parenthesis, is considered among the Fox to be the most dread form of witch. An Indian informant, who, significantly enough, wished to remain anonymous, stated that he himself had seen certain members of the gens remove stones or feathers from a box without touching it or its contents. Balls of fire were produced, and skins of snakes and cat and otter skins came alive and spoke. In the matter of the closed box the identity with the West African claim is noteworthy. Other performances resembled those of the spiritualistic medium. Stones ran round in a circle. The witches successfully called on the Wâpanowi birds (spirits) to come; they handled red-hot coals without suffering harm, and plunging their bare arms into boiling water, took out meat with impunity. This last feat has been recorded among a number of the American Indian peoples.

AN attempt by Fox Indian witches to injure or kill an individual who sought to ward off their attempts on his sister, was frustrated by giving them a feast at which the food provided by their host and intended victim was the head of a witch who had been captured by burning cedar leaves. When the witches invited him to a ceremonial feast, they were unable to take the meat from boiling water with bare arms, but he succeeded; they handled red-hot coals and he did the same. Then they became afraid. The next day the ceremony ended without any special event. Presumably the intended victims had evaded the danger. It will be remembered that it was claimed for the notorious medium Home that he had transferred his immunity to red-hot coal to someone else for a brief period; but with the Fox the transfer would seem to have been involuntary, although, it is said, the intended victim had been told previously "how to excel in shamanistic tricks". It has been questioned whether medicine men and shamans have the hypnotic powers sometimes claimed for them—rather, it is to be feared, as the last resource of an exhausted attempt at explanation; but it may be noted that it is said of one Fox witch that "when he was looked at steadily by anyone, the other became sleepy, . . . and . . . when [anyone] did not take his gaze from him, he fell asleep".

Anniversary of the Science Museum

THE South Kensington Museum was first opened to the public on July 1, 1857, and the seventy-fifth anniversary is being marked at the Science Museum by a special exhibition of technical apparatus, etc., which will remain on view until October. The wonderful progress which has been made in all branches of science and technology is shown by exhibiting examples which were in use during the decade 1850–60 alongside the corresponding types which are in use to-day, and emphasising the contrast in the descriptive notices. Air, land, and water transport are represented, and the remarkable advances which have been made in mathematical instruments, lighting equipment, telegraphy, typewriters, sewing machines, marine engines, pumping machinery, stationary engines, metallurgy, and other fields are shown by actual examples or by scale models. The discovery of the first artificial dye by W. H. Perkin in 1856 provides a very striking example of the progress made in industrial chemistry when the products of that date are compared with those of the dyeing industry of to-day. Besides a type exhibit placed among the others of the exhibition, a much larger and more representative display of modern dyes and dyed materials has been arranged in Gallery 66 on the top floor of the Museum. A series of plans shows how the Gore Estate has been developed by the Commissioners of the Great Exhibition of 1851 during the past eighty years, from the original group of green fields to the great intellectual centre which it is to-day. Since the South Kensington Museum, now represented by the Victoria and Albert Museum and the Science Museum, was established on the initiative of the Prince Consort, the attendance records total more than seventy-eight million, and about two million visits annually are still recorded.

National Prosperity and Control of Production

IN a pamphlet entitled "The Next Step", Capt. Harold Macmillan, M.P., advances the proposition that prosperity is conditioned by equilibrium in production. If the forces of production are properly distributed in the production of consumptive goods, and if the rate of saving is equalled by the rate of capital investment, then the total products will exchange against each other and prices and employment will be stable. This is the ideal production balance, but the difficulty of maintaining it becomes evident when it is visualised as a continuous rather than a static balance. Fluctuations are inevitable, and the balance may be upset by financial, political, or industrial forces. Capt. Macmillan therefore argues that it is necessary to create an organisational structure which will guide the flow of capital investment, secure the production of commodities in the quantities which scientific market study directs, and maintain stability of prices as the governing principle in credit policy. To attain these ends, he advocates the following programme: (1) a scientific system of selective protection of our home market; (2) the establishment of representative national councils for each industry, to co-ordinate purchasing, production, marketing, and research; (3) the creation of an investment and development board representing the Government, industry, and finance, to direct investment into the correct channels, to influence credit policy, and to direct the efforts of the councils of industry so as to achieve a new internal production balance in relation to the most scientific estimation of market requirements; (4) reflation to the 1928 price level.

CAPT. HAROLD MACMILLAN also advocates the "planning of stability". He argues that Britain has inherited a population and economic structure adjusted to a stage of world development which is past. Adjustments must now be made which ought to have

been taking place in response to these changes as they occurred, while in the future continuous adaptation will be required. Britain has now entered a period in which planning—conscious direction and intelligent anticipation—is essential to national welfare. Industry is already striving towards that integration and unity which modern conditions demand, and these efforts must be assisted. A sufficient measure of centralisation of control is required to enable the activities of separate industries to be brought into harmony with the economic objectives essential to national welfare and prosperity as a whole. The units of productive effort need to be controlled by a co-ordinating central authority sufficiently representative and sufficiently powerful to direct capital and labour into the correct channels to maintain equilibrium. Even already, Britain has been moving into this field of conscious endeavour by the road of protection, agricultural marketing, the regulation of wheat and coal production, the centralised direction of electrical power distribution, and now by the subordination of credit to the needs of industry. Mistakes have, of course, been made in the past, but improvements will have to be carried out as experience is gained.

New Index Number of Profits

IN his valedictory address on June 21 as president of the Royal Statistical Society, Sir Josiah Stamp described a new index number of profits, which he has constructed. This consists of a general index of profits designed to show changes in the return to capital as a whole and a special sub-index showing variations in the return for risk-bearing capital (ordinary shares, etc.). Both indices are comparable with the index of production, the various price indices, and other statistics. For technical reasons, the year 1924 has been selected as the base period, but the numbers have been carried back to 1920 as shown in the following table:

Year.	General Index.	Special Index.
1920	107·0	112·0
1921	68·7	57·3
1922	90·4	84·6
1923	94·1	90·6
1924	100·0	100·0
1925	104·1	109·3
1926	98·3	103·0
1927	106·5	111·4
1928	106·2	110·7
1929	109·9 *	114·3
1930	100·9 †	94·4
1931	92·0 †	80·9 *

* Provisional, subject to early verification.
† Very provisional.

Sir Josiah Stamp pointed out that his index referred to changes in the *aggregate amount* of profits, and not to the *rate of return* on capital. Inasmuch as a large increase has taken place in invested capital since 1924, the fall in the rate of return per unit of capital is greater than that of any fall indicated by the aggregate index. The index shows that the range of boom and depression is far smaller in Great Britain than in the United States.

The Patents and Designs Bill

CONFIDENCE which was placed in the Joint Chemical Patents Committee on its formation has been fully justified by the record of its activity. This committee of the Association of British Chemical Manufacturers, on which the Chemical Society, the Institute of Chemistry, and the Institution of Chemical Engineers are represented, gave evidence before the Board of Trade Departmental Committee on the Patents and Designs Acts and the practice of the Patent Office, during the inquiry which extended over eighteen months. The Patents and Designs Bill recently introduced into Parliament proposes to give effect to the recommendations of this Departmental Committee, generally known as the Sargant Committee; on publication, the Bill was examined by the Joint Chemical Patents Committee, and was considered still to contain a number of points of importance requiring amendment. As a result of the presentation of a memorandum to the Board of Trade, followed by a deputation, almost all the desired amendments have been secured at the committee stage of the Bill. For example, more effective provision for dealing with the abuse of user patents, whereby the manufacture of non-patented substances was being restricted or entirely prevented in Great Britain, has been obtained. The section dealing with the remedy in case of groundless threats of legal proceedings has been amended, and the appeal tribunal is to have power to obtain the technical assistance of an assessor in all cases. So far as the costs of appeal are concerned, the present atmosphere of appeals to the law officer is to be preserved, although in certain respects the tribunal will be regarded as a court of the High Court. It is a valid claim that these major amendments will both strengthen the new Act and afford great assistance to the poor inventor.

Prof. H. Brereton Baker

ON the occasion of his seventieth birthday, Prof. H. Brereton Baker and Mrs. Baker were, on June 25, entertained at dinner at the Imperial College of Science and Technology by a number of colleagues and former pupils. The rector of the Imperial College, Mr. H. T. Tizard, presided, and the company included distinguished representatives of those who had been associated with Prof. Baker's work at Dulwich College, at the University of Oxford, and at the Imperial College, London. *Ave* was, however, accompanied by *Vale*, for at the end of the present academic year Prof. Baker retires from the directorship of the Chemistry Department of the Imperial College and from his chair of chemistry in the University of London; fortunately, however, Prof. Baker will continue actively to prosecute his researches, and will occupy accommodation which has been placed at his disposal for that purpose by the College. Tribute was paid to Prof. Baker's work, both for chemical science and for the institutions with which he has been associated, by Mr. Tizard, Mr. R. T. Lattey, Mr. D. L. Chapman, and Prof. H. E. Armstrong. During the evening an inscribed album was presented to Prof. Baker, and Mrs. Baker was asked to accept a piece

of jewellery; decision regarding the nature of the principal gift awaits the intimation of Prof. Baker's wishes. It is known, however, that Prof. Baker, whose interest in the establishment of the College hostel has resulted in so marked a development in the students' social life, is anxious to commemorate his association with the Imperial College by placing a clock in the quadrangle, and intends to devote the major part of the presentation fund to that purpose.

New Buildings at Rothamsted

THE annual inspection of the experimental plots and laboratories at Rothamsted on June 21 was made the occasion of the official opening of a new block of buildings at the farm and the inauguration of an extensive electrical installation in the farm buildings. The Right Hon. Sir John Gilmour, Minister of Agriculture, declared the buildings open, in the presence of a large gathering of guests representing all branches of agriculture and the allied industries, and many of the visitors came from distant parts of the Empire. The new block of buildings will serve both the field experimental and demonstration sides of the farm. It contains an artificial manure store, working and office accommodation for the field experimental staff, and equipment to deal with the drying and preparation of the numerous samples taken in the course of the modern experiments. The purpose of the demonstration room is to facilitate the presentation of the field results which have direct practical interest in a way which is easily grasped by visitors. Diagrams and models take the place of tables of figures. Good types of machinery are illustrated, successful rations fed on the farm are on record, and exhibits of plant disease are set up as they become available. The electrical installation, designed by the General Electric Company, Ltd., will be of the most modern and complete kind, and will provide very valuable information as to the cost and general efficiency of motor-driven farm machinery in comparison with the older oil-driven type. The many visitors to Rothamsted are always interested in the excellent collection of modern implements loaned or presented by the makers. The installation of electrical equipment will greatly add to the demonstration value of this side of the farm.

Southern Railway Electrification

APPRECIABLE progress is being made on the Southern Railway's London-Brighton electrification scheme. According to the *Electrician* of June 24, 'stream-lined' electric trains have been undergoing night time tests. The first half of the new scheme—the extension to Three Bridges—will be opened on July 17. Thirty-three new trains will be employed, fitted with high speed motors and stream-lined, so that speeds of 70 miles an hour will be possible. The third class compartments have been built like the old first class compartments, and extra width has been given to the seats. The coaches have been built to the maximum width limit of the track, so it is impossible to use the 'bay window' type of look-out for the guard. The guards will see the signals through a periscope which projects through the roof. The signalling system has been changed throughout the route from the semaphore to the colour-light type. Whenever a train passes, the signals are automatically put to danger. An ingenious device is fitted in every signal-box which enables the signalman to know the exact nature of the trains that are approaching and their times. From July 17 there will be 61 trains running daily from London to Three Bridges, compared with 27 at present, while Three Bridges will have 57 trains to London in place of 19. The fastest trains have been timed to do the 30 miles in 39 minutes, but the average time for all the trains has been reduced from 60 to 52 minutes. The second stage of the scheme will probably be completed by March next.

Gyro-stabilisers for Liners

ALTHOUGH the theory of the gyroscope has been taught for more than fifty years in several universities, it is only recently that the instalment of gyro-stabilisers for ships, yachts, and aircraft carriers has begun to be adopted. The largest gyro-stabilising plant in the world has recently been completed for the new 46,000-ton luxury Italian liner *Conte-di-Savoia* at the works of Messrs. Vickers, Armstrong, Ltd., Barrow-in-Furness. An interesting account of the plant is given in the *Metropolitan-Vickers Gazette* for April. The plant consists of three identical stabiliser equipments, each one of which can function as a stabiliser independently of the other two. The rotating element in each consists of two solid forged steel disks. The rotating part (the rotor) weighs 110 tons and at normal working speeds it rotates at 910 revolutions per minute, being driven by a spinning electric motor mounted directly on the shaft. This motor is of the three-phase type and gives 560 horse-power at the normal speed. It is capable of giving 750 horse-power for 90 minutes during the accelerating period. The Sperry gyro-stabiliser is used, and this never allows the vessel to start rolling. A single wave can start a roll. In an unstabilised vessel, should the period of the rolling swings and the waves be the same, resonance might occur, and if the damping were small the rolling might become dangerous. Usually, however, the waves are only synchronous with the ship's natural swing for a brief period, and so its maximum swing is due to the accumulated effects of the waves. The Sperry device quenches the effects of these waves one by one, and so the stresses and strains on the hull of a stabilised ship are comparatively slight.

Human Improvability

DR. C. S. MYERS contributes an article on "Human Improvability" to a recent issue of the *Bristol Medico-Chirurgical Journal* (vol. 49, No. 183). He says that the problem of human improvability is as interesting as it is difficult. One difficulty lies in the definition of *improvement*, which is not necessarily synonymous with *progress*, and for which we can have only subjective criteria. The prevailing biological view is that all changes in living form and function are evoked by accident, and are perpetuated by heredity and by their suitability to the environment; improvement might then be regarded as involving a more perfect adaptation to the physical and social environment.

Some thinkers, however, find such a view inadequate to account for the facts, and therefore postulate in addition some, to us unknown, purpose in the universe. Our developing knowledge of other peoples has replaced many illusions as to natural differences by the recognition of likenesses as well, and confirms the importance of the social environment. It is not unlikely that man's mental and moral development depends in part upon the relation between his inheritance and the physical and social environment in which he grows up. Dr. Myers analyses several modern environmental conditions and concludes that changes have occurred which justify a belief in human improvability; these improvements do not, however, appear to come from the innate improvability of a race but from the improvement in the social heritage. The paper is provocative and stimulating, and in view of Dr. Myers's intimate knowledge of many aspects of modern civilisation, it is worthy of very serious consideration. It is all the more important at the present time, when so much pessimism is shown in the interpretation of the changes which our environment is experiencing.

British Poisonous and Edible Plants

EXCEPTING works on poisonous plants from the agricultural and medical points of view, there is very little printed information available to the lay reader. Fortunately, most British poisonous plants are rare; but the most dangerous are those with an attractive and luscious appearance. Perhaps that is why, despite their scarcity, such plants are the cause of illness and even death to unwary ramblers, campers, and school children every year. The pamphlet recently published as a reprint from *School Nature Study* therefore comes as a timely warning, not only to the country child and the town child in the country, for whom it is written, but also to adults who take an active part in country life. The pamphlet, "British Poisonous and Edible Plants", written by Miss Hilda F. Rendle, after a few introductory remarks, gives a list of edible plants found growing wild. These are divided into black fruits, scarlet fruits, seeds and nuts, flowers, leaves, roots, and fungi. The second part deals with the poisonous plants, giving not only the well-known plants such as laurel, bryony, deadly nightshade, etc., but also some of the less familiar types such as the spindle with its attractive pink fruit and orange seeds, potato 'apples', and acorns. A few of these are illustrated. It is a pity that the fungi were not given more space. Only the common mushroom (*Psalliota*) is described, with the concluding remark that "all other fungi should be avoided". In the present day of extended country activities, this pamphlet should be welcomed by all school teachers, boy scouts troops, country rambling organisations, etc. Copies at 2½*d.* each or two shillings per dozen can be obtained from Mr. E. G. Clarke, 7 Stanley Avenue, Wembley, Middlesex.

Acquisitions at the Natural History Museum

THE Department of Botany, British Museum, has received 320 plants collected by Mr. H. St. J. B. Philby, on his recent Arabian journey and presented by the King of Hejaz and Najd. The plants are of interest botanically as being from an area previously unexplored. It has to be remembered that, from an economic point of view, plants are of the greatest importance in deserts, and according to Mr. Philby the Arabs know them so well as camel food or otherwise that they are able to judge the date of the last rains from their presence or absence. The Arab name is attached to each plant. Acquisitions of the Department of Minerals include meteorites collected by Mr. Philby, a piece from the 15-ton mass of meteoric iron discovered in 1930 near Mbosi in Tanganyika Territory, a piece of a meteoric stone which fell recently near Kirkuk, Iraq, and a specimen of pitchblende from the recently discovered occurrence on the Great Bear Lake, North-West Territory, Canada. Dr. Robert Broom has presented to the Geological Department a small series of South African fossil reptiles, several of which are the types of genera and species recently established by the donor. They belong principally to Therocephalian and Dicynodont genera, and range from Permian to Trias in age. Through the generosity of Rear-Admiral H. Lynes, Mr. Jack Vincent has been collecting for the Museum in Portuguese East Africa, the birds of which are very little known; already two consignments have been received. A collection of more than a thousand birds from Yunnan obtained by the late Mr. G. Forrest, the well-known plant collector, has been presented by the Godman Exploration Fund, while Dr. P. A. Buxton has presented a collection of some 750 birds made by him during the War in Iraq and Persia.

Publications of the Institut Henri Poincaré

THE completed first volume of the *Annales de l'Institut Henri Poincaré* (Paris: Institut Henri Poincaré; Les Presses Universitaires de France) contains a highly interesting set of papers on theoretical physics and its mathematical borderland, of varying degrees of difficulty, several of which have been referred to in our columns on their appearance. The contributions verging on the purely mathematical include two on integral equations, by Kostitzin and Carleman, one by Brillouin, on a hyperbolic equation, and two, by Lévy and Polya, on the calculus of probabilities. Relativity is represented by Einstein and de Donder, and quantum theory by Darwin, Fermi, Born, and Dirac. The other papers are by Brillouin, on fusion, and by L. Bloch, on band spectra. It will be evident that the list of authors is one of unusual authority, a feature continued in the first numbers of the second volume by the inclusion of Sommerfeld and Cabrera. Their respective papers also give in short the aim of all, which appears to be to comment on current problems, or to collect and criticise otherwise scattered work. The papers are based on lectures delivered under the auspices of the Institut Henri Poincaré, and the only important change to be desired is that less time should be allowed to elapse between the delivery of the lecture and the time when it appears in print.

Population of England and Wales

THE "Text" (final) volume of the Registrar-General's Statistical Review, England and Wales, 1930, has been published (H.M. Stationery Office, 2*s.* 6*d.*

net). It contains the official commentary on the vital statistics contained in Parts i. and ii., Medical and Civil Tables, already issued. The population at the middle of the year was estimated at 39,806,000 persons, made up of 19,075,000 males and 20,731,000 females, the excess of females being most marked in the age groups between thirty and fifty-five years. The death-rate, 11·4 per 1000 population, is the lowest on record. The deaths ascribed to cancer (57,883) are the highest yet recorded, but when standardised are almost the same as, and no higher than, the preceding year. Attention is directed to the increasing mortality associated with motor-vehicles, and particularly with motor-cycles. During the six years 1925–30, motor-cycles were associated with the deaths of 2752 young men between the ages of fifteen and thirty-five years, which is 2·8 times the number killed in the preceding 14 years. The corresponding numbers of young women were 316 and 79, a fourfold increase.

Grant in Aid of African Research

A FURTHER grant in aid of research in Africa by the trustees of the Rockefeller Foundation is announced. The sum of £3000 per annum for a period of three years has been granted to the School of Oriental Studies in the University of London for the furtherance of research in African linguistics. This subject is already included in the curriculum of the school as part of the work of the Department of Phonetics and Linguistics, acting in co-operation with the International Institute of African Languages and Cultures. Now that the Oriental Institute has this additional fund at its disposal, it will be possible to extend its activities in this subject especially in the field of original research. It will be remembered that the Rockefeller Foundation is already assisting liberally African research in Great Britain by the grant of £5000 a year, to be increased in certain contingencies to £10,000, to the International Institute of African Linguistics and Cultures; and this grant is being used to meet the cost of a scheme of research which has been planned to cover a period of five years.

Announcements

SIR WILLIAM BRAGG, director of the Royal Institution, left England on June 25 for a lecture tour in South America under the auspices of the Ibero-American Institute of Great Britain, of which H.H. the Prince of Wales is president. On the previous day Sir William was received by His Highness, who expressed his interest in the tour. Sir William is due at Buenos Ayres on July 15 and leaves there on Aug. 1, when he goes on to Rio de Janeiro, arriving there on Aug. 6 and staying until Aug. 14. At both places he will be the guest of the British Ambassador and will deliver lectures on recent work on X-rays and crystal analysis. Sir William is expected back in England about Aug. 29.

As noted briefly in our issue of June 11, p. 860, the centenary of the birth of Sir William Crookes fell on June 17. In 1859 he founded the *Chemical News*, and the issue of that journal for June 17 is very appropriately dedicated to his memory. Lord Rutherford contributes a descriptive article on the artificial transmutation of elements, Sir Harry McGowan has a short article on Crookes's well-known forecast of a world wheat shortage in relation to chemical industry, and other articles deal with various aspects of Crookes's life and scientific work. The issue includes full-page reproductions of photographs of Crookes and Lord Rutherford.

THE Medical Research Council announces that, on behalf of the Rockefeller Foundation, it has made the following awards of travelling fellowships for the academic year 1932–33; these fellowships are awarded to graduates who have had some training in research work either in the primary sciences of medicine or in clinical medicine or surgery, and who are likely to profit by a period of work at a chosen centre in America or, in special cases, in Europe, before taking up positions for higher teaching or research in the British Isles:—Mr. C. P. Beattie, Bacteriology Department, University of Edinburgh; Mr. W. D. W. Brooks, St. Mary's Hospital, London; Dr. Eleanor M. Creak, Maudsley Hospital, London; Mr. I. G. W. Hill, Royal Infirmary, Edinburgh; Mr. W. A. Mackey, Department of Surgery, University of Glasgow; Mr. D. J. Macmyn, King's College Hospital, London; Dr. J. C. Moir, University College Hospital, London. In view of the high qualifications of so many of the candidates, the Council greatly regrets that it has not been possible to make a larger number of awards.

MESSRS. H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1, have just issued a very useful classified catalogue of books, in new condition, on physics and mathematics. An admirable feature is the insertion of the year of publication of each volume.

UPWARDS of 2000 works dealing with ornithology are offered for sale, at what appear to be reasonable prices, by Messrs. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2, in catalogue New Series, No. 28. The catalogue is obtainable free upon application.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time lecturer in the Department of Building of the Leeds Technical College—The Director of Education, Education Department, Calverley Street, Leeds (July 6). A teacher of metalwork and technical drawing, and an assistant master to teach principally chemistry and mathematics, in the Junior Technical School of the Castleford, Normanton, and District Mining and Technical Institute, Whitwood—M. G. Swaine, Education Offices, Castleford (July 8). An assistant lecturer in mathematics in the University of Birmingham—The Secretary, The University, Birmingham (July 15). A lecturer in pharmacology in the Department of Physiology of the University of Bristol—The Secretary and Registrar, The University, Bristol (July 22). A secretary of the Jamaica Agricultural Society—The Secretary, Jamaica Agricultural Society, 11 North Parade, Kingston, Jamaica, B.W.I. (Sept. 5).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Early Man in Java

THE paragraph on early man in Java, in NATURE of June 11 (p. 863), concerning the Ngandong skull, induces me to make the following remarks.

Mr. W. F. F. Oppenoorth, who described the skull, says in the Summary, p. 63 of his paper :[1]

"Just in those features, where the Ngandong skull deviates from the Neanderthal type—especially in the shape of the occipital bone—it approaches a skull, found some ten years ago in South Africa, now known in literature as the Rhodesian skull ; the torus supraorbitalis, however, of the Ngandong skull is not so heavy and a little more bent.

"The back of the Ngandong skull also bears resemblance to that of the Australian race, so perhaps we may see in it a much more primitive prototype of that race than was the Wadjak man of Dubois.

"I think it justifiable to separate the Ngandong skull and call it *Homo (Javanthropus) soloensis*, n. subg., n. sp."

I may here direct attention to the well-known fact that in the slope of the nuchal plane of the occipital bone, there is a wide range of variation in Australian skulls, and there is also great individual difference, in this respect (among other things), between the two skulls of Wadjak man,[2] from one of which only I described the strikingly primitive upper and lower jaw, the brain case and the other bones of the face being in a fragmentary and incomplete condition. This skull much more approaches the Ngandong skull, in the shape of the occiput and in other respects.

A careful study of Oppenoorth's paper, which is called a 'preliminary' report, leaves little doubt, however, in my mind, that Ngandong man and Wadjak man are one identical type. The new skull, in my opinion, bears out the proto-Australian character of the Wadjak type, and also tends, I believe, to designate Rhodesian man as the prototype of the species *Homo sapiens*.

EUG. DUBOIS.

Haarlem,
June 11.

[1] *Homo (Javanthropus) soloensis*, een Pleistocene Mensch van Java (Voorloopige mededeeling). Wetenschappelijke Mededeelingen No. 20 van den Dienst van den Mijnbouw in Ned.-Indië, pp. 49-63, six plates. Batavia, Landsdrukkerij, 1932.

[2] Described in *Proc. Kon. Akad. Wetenschappen*, Amsterdam, vol. 23, pp. 1013-1051, two plates ; 1921.

The Inheritance of Acquired Characters

PROF. MACBRIDE'S criticism[1] of my lecture on the inheritance of acquired characters falls into three parts. He claims that I have misinterpreted Lamarck, that certain experiments demonstrate the transmission to the offspring of characters acquired as the result of a change of environment, and finally that this latter principle can be inferred from other facts, apart from the results of any experiment.

Lamarck, as I pointed out, used different language on different occasions. I think that my second citation from him shows that, sometimes at least, he expressed the views which I attributed to him.

I am glad that Prof. MacBride does not deny that Dürken employed selection. But, he writes, "selection as an effective cause of anything is a superstition that dies hard". Selection is quite an effective cause of change of the proportions in which various types occur in a mixed population. And such a change was all that Dürken obtained. Some of his original population gave green pupæ. He selected these, and got a larger proportion in later generations. The facts cited by Prof. MacBride in his letter as to the behaviour of certain larvæ in orange light are irrelevant to the issue, namely, whether this treatment, apart from selection, increases the proportion of green pupæ *in a given environment*, in successive generations.

I must apologise, in this connexion, for writing *Pieris rapæ* for *P. napi*. I must also apologise to readers of NATURE for quoting Prof. MacBride's account of Metalnikoff's experiment rather than the original. I have read three accounts by Metalnikoff of his experiments, and from none of them can I discover whether he bred from those caterpillars which had been immunised both with living and dead bacteria, as appeared from Prof. MacBride's lecture, or only from the latter class, as he states in his letter. The interpretation of his results depends on which alternative was true.

Prof. MacBride dismisses a hypothesis which he attributes to me as "fantastic", on the ground that *Salix rubra* is a rare hybrid. Actually it is of such economic importance that three different strains of it are grown for basket-making, and common enough to occur in sixty-nine of Druce's British vice-counties. On the other hand, the original host species *S. andersoniana* is an economically unimportant plant occurring in only thirty-four vice-counties. The hypothesis that some of the ancestors of flies colonising the latter had lived on the former does not appear particularly fantastic. Of the "larval memory hypothesis" we read that "it assumes that the instinct of the mother to seek a certain plant and the capacity of the larva to live on this plant are inseparable". After discussing the larval memory hypothesis I actually wrote, "The *other* factor in successful colonisation is the ability of the larva to eat and digest its food". The assumption (which is clearly false) was therefore Prof. MacBride's and not mine.

Against the eminent authorities cited in favour of Lamarckism, I will only quote one, namely, the Royal Society's motto, "Nullius in verba". I am awaiting such experimental confirmation of their views as would be furnished by a successful repetition of McDougall's experiment.

To call the alternative theory that of "Chaos and Chance" does not, of course, disprove it. The kinetic theory of gases proves that chaos and chance can form the basis of very exact and fully verifiable predictions. Unfortunately for the kinetic theory of species, conditions in a natural population are not chaotic. Mutation does not occur in all directions. From a knowledge of the types of mutation common in one species we can predict those common in another. And mating is not in general at random. If a species were a real chaos, the theory of evolution would be nearly as simple as the kinetic theory. So I fear that Prof. MacBride's phrase may have led readers who are acquainted with that theory to suppose that the case for neo-Darwinism is even stronger than is actually the case.

J. B. S. HALDANE.

Roebuck House,
Ferry Lane,
Cambridge.

[1] NATURE, 129, 900, June 18, 1932.

Developments in the Chemistry of the Anthocyanins

IT is a remarkable fact that almost the whole range of anthocyanin pigments of flowers, fruits, and blossoms is derived from the three fundamental anthocyanidins, namely, pelargonidin, cyanidin, and delphinidin, by various substitutions in the hydroxyl group. A very extensive survey of the colouring matters of this class conducted during the last two seasons has only served to emphasise the prevalence of the three known types.

Nevertheless, the existence of exceptions has already been recognised by Willstätter, who found that the bluest anthocyanins occurring in the beet, in *Celosia cristata*, and in *Atriplex hortensis* are nitrogenous pigments. At the other end of the scale, the most yellow anthocyanin was noted in *Papaver alpinum*, and a similar substance which colours the yellow Iceland poppy is in progress of investigation in this Laboratory by Miss R. Scott-Moncrieff. Quite a different anthocyanin has now been found to occur in the orange-red flowers of *Gesnera fulgens* (or *G. cardinalis*). This anthocyanin we propose to term *gesnerin*, and it is a 5-saccharide (unidentified sugar residue) of 4′ : 5 : 7-trihydroxyflavylium chloride. On hydrolysis it yields the anthocyanidin chloride which was readily identified as apigeninidin chloride,[1] the synthesis of which was effected in 1925 because it was thought probable that a derivative of the substance would occur in Nature. The major anthocyanidins are related to naturally occurring flavonols and it was thought probable that similar substances derived from the flavones in a similar way might be encountered ; this expectation has now been realised in the case of the anthocyanidin related to the flavone apigenin. A further search among the Gesneriaceæ and other families of the Personales will be made, since it seems very probable that the anthocyanin derived from luteolinidin will also be encountered.

The suggestion first made in these columns, that some of the more important anthocyanins are 3 : 5-diglucosides, has been amply confirmed by synthesis. Dr. A. R. Todd in collaboration with one of us has already succeeded in synthesising hirsutin, malvin, and cyanin chlorides, and synthetical indications have been obtained in regard to peonin and pelargonin chlorides ; all these pigments bear two glucose residues separately attached to oxygen atoms in positions 3 and 5 of the anthocyanidin molecule. An independent confirmation of the correctness of these views is obtained from the work of Prof. Karrer and his colleagues, who have been able to show that the process of oxidation of many anthocyanins by hydrogen peroxide, followed by hydrolysis, results in the detachment of only one hexose unit, obviously that attached to position 3 (private communication). The hypothesis that anthocyanins of the mecocyanin type are 3-biosides has also been confirmed by synthesis of representatives of all the possibilities (for example, cyanidin 3 : 7-diglucoside, 3-cellobioside, and 5 : 7-diglucoside), and by an examination and comparison of their properties.

We were naturally much interested in the letter of Mr. W. J. C. Lawrence[2] on the subject of the co-pigments which modify the colour of dahlias, pelargoniums, etc., as we have long been of the opinion that the chief co-pigments are the tannins and anthoxanthins, including the flavone and flavonol glucosides. Until, however, these substances have been isolated and identified, speculation as to their nature seems premature. Nevertheless, experiments with pure anthocyanins and pure flavonol derivatives have proved very suggestive, and, for example, the appearance and properties of a co-pigmented violanin solution from purple violas can be simulated by means of a synthetic anthocyanin in association with quercitrin.

We have found the phenomenon of co-pigmentation almost universal in flower colours, almost all of which are bluer than they should be at the *p*H obtaining in the cell sap. The degree of the effect is, however, very varied in different flowers, and, as we have already suggested, a genetic factor for flower colour is frequently connected with the development (or, it may be, the suppression) of a co-pigment.[3]

In addition, we pointed out that the co-pigment might remain as a constant factor in certain cases, and that a change of colour tone might result from an increase in the concentration of the anthocyanin. Thus in the ordinary lilac there is a co-pigment, found also in the white flowers, which with a low concentration of anthocyanin produces the familiar pale mauve colour ; the deeper red shades are the result of an increased proportion of colouring matter, and the deep bluer red varieties contain both pigment and co-pigment in greater concentration. An alternative to the latter part of this statement is obviously that a new and more efficient co-pigment has been developed.

G. M. ROBINSON.
R. ROBINSON.

Dyson Perrins Laboratory,
University of Oxford,
June 14.

[1] Pratt and Robinson, *J.C.S.*, **127**, 128.
[2] NATURE, **129**, 834, June 4, 1932.
[3] *Biochem. J.*, **25**, 1687 ; 1931.

Mass-Spectra of Helium and Oxygen

IN the course of my analyses of leads of different origins I have had opportunity of making some interesting observations on these two elements. While preparing a new discharge tube by preliminary running, a mixture of helium and oxygen was used and a search was made for the line due to He^{++}. The occurrence of doubly charged helium atoms *in the discharge* was inferred during the early work of Sir J. J. Thomson[1] and has recently been very beautifully demonstrated by Conrad,[2] but the evidence in each of those cases was indirect, namely, the prolongation of the normal helium parabola. All attempts so far made to photograph the line of He^{++} as a satellite of the line H_2 by means of the mass-spectrograph have been unsuccessful.

These failures I have ascribed to my use in the past of cooled charcoal (incapable of absorbing helium) for the high vacuum parts of the apparatus. This explanation appears to be correct, for by reducing the pressure in the slit system and the camera to a much lower value by a diffusion pump and lowering the intensity of the H_2 line by continuous washing with oxygen and helium, the doubly charged line of the latter has now been found. It is indeed still much too faint compared with H_2 for accurate measurement, but there is now reasonable hope that with a setting of the discharge tube more favourable to atomic lines and more careful washing it will be possible to reduce the pair to approximately equal intensity. The distance between these lines will then afford a really direct and trustworthy measure of the ratio of the masses of the helium and hydrogen nuclei, a figure of fundamental importance in nuclear physics.

During these experiments it was noted that the helium-oxygen mixture gave much stronger oxygen lines than did pure oxygen, and since the oxygen molecular line was so bright that it could be seen on the willemite screen, conditions were very favourable for the detection of the two faint isotopes of oxygen. The atomic lines 17 and 18 are unsuitable for this, owing to the presence of OH and OH_2, but the molecular lines 33 and 34 due to $O^{16}O^{17}$ and $O^{16}O^{18}$ respectively may be expected to be fairly free from

contamination. Furthermore, their intensities relative to the main line 32 will be double those of atomic abundance. On photographing the spectra all three lines were quite clear, and by giving suitable exposures, for example, 3 seconds and 15 minutes, their relative intensities could be estimated. Line 32 was found to be 268 times as intense as line 34, which was 4·2 times as intense as line 33.

These can only be regarded as rough minima, for owing to the action of the oxygen discharge on the wax and grease it is certain that sulphur is present, and if to the extent of 1 per cent, would enhance line 34 by about ten per cent and line 33 even more. It is clearly useless to push the accuracy further until an apparatus is available from which sulphur and other possible sources of contamination can be excluded, but so far as they are valid, the ratios 536 and 4·2 support the figures 630 and 5 given by Mecke and Childs [3] as against the lower abundances previously estimated.

F. W. ASTON.

Cavendish Laboratory,
Cambridge, June 16.

[1] "Rays of Positive Electricity", 83; 1921.
[2] *Phys. Z.*, **31**, 888; 1930.
[3] *Z. Physik*, **68**, 362; 1931.

An Ocean Sunfish in Malaysian Waters

THE species under consideration (*Mola lanceolata*) is so rare that I venture to think that a preliminary note on a recent capture may not be out of place in the columns of NATURE. A more detailed account will, it is hoped, appear in the *Bulletin of the Raffles Museum* during the course of the year.

A specimen of an ocean sunfish, *Mola lanceolata* (Liénard), was taken in a fishing-stake at Noembing, off Bintan Island in the Rhio Archipelago, during the night of April 11–12, 1932. Fortunately, the owner of the stake realised the unusual nature of his catch and presented it to this Museum.

The adult specimens now known appear to be as follows:

1. The type, described by Liénard in 1840, taken off Mauritius.

2. A specimen taken off Amboina and described by Bleeker in 1873 as *Orthagoriscus oxyuropterus* (*Vers. Akad. Amsterdam* (7), **2**; 1873). The "Zoological Record" for that year contains a reference to the possible identity of this species with *O. lanceolatus*, and Fowler (*B. P. Bishop Museum Occasional Papers*, **8**, No. 7, 1923, 387) includes it in the synonymy of *Masturus lanceolatus*.

3. A large specimen (2 metres in length) taken near the Azores by the Prince of Monaco (Johs. Schmidt, NATURE, **107**, 76; 1921).

4. A specimen in the Honolulu Museum recorded as *Masturus lanceolatus* by Jordan and Jordan (*Mem. Carnegie Mus.*, **10**, No. 1, 89; 1922, fig.). The authors refer to it as the third recorded specimen, but had evidently not seen Schmidt's work. A fuller account is given by Fowler ("Fishes of Oceania", *Mem. B. P. Bishop Mus.*, **10**, 474; 1928, fig.).

5. The present specimen. Like that from Honolulu, it is about 4 ft. in length.* The spotting of the caudal is much as in Fowler's figure, but only extends slightly on to the bases of the other vertical fins. The small gill opening is in the form of a short funnel, projecting backward, and there can be little doubt that it is used as an auxiliary steering apparatus by squirting out a jet of water, as suggested by Capt. Damant for *Mola mola* (NATURE, **116**, 543; 1925).

* According to Jordan and Jordan, the Honolulu cast is 4 ft. in length; presumably, therefore, this represents the length in life, but Fowler gives the length of the spirit specimen as 948 mm., or just over 3 ft.

The cartilaginous layer under the skin has a thickness in parts of about 1½ inches. The flesh was strikingly white, tender, and watery, disintegrating rapidly when scraped. In the stomach was a sucker-fish (*Echeneis remora* Linn.), 8 inches in length.

The remarks of Schmidt (loc. cit. and NATURE, **117**, 80; 1926) on the early stages of *Mola lanceolata* and allied species are of very great interest in view of the wide range from which the few known adults of *M. lanceolata* have been taken. If any specific or racial distinction could be found between these specimens, it would be logical to look for local breeding grounds. In the case of a single species, it would appear from Schmidt's conclusions that the Sargasso Sea is the nursery, and the wide distribution must be attributed solely to the action of ocean currents.

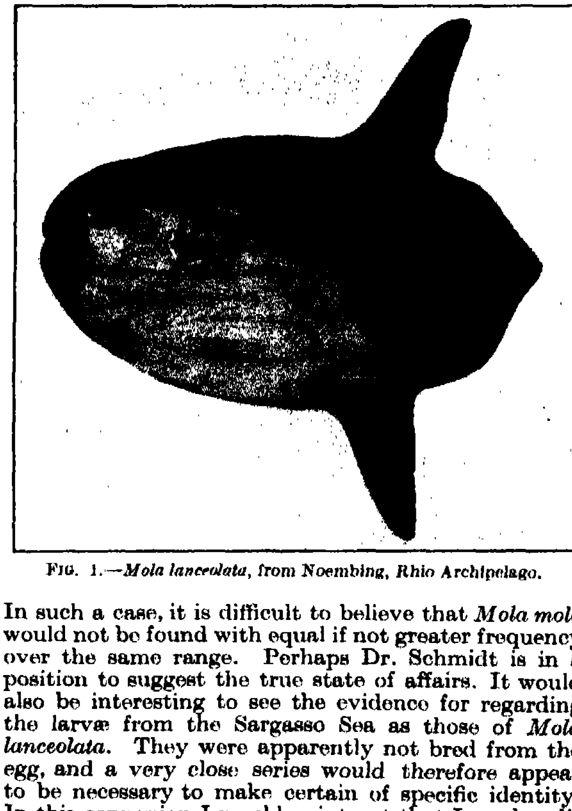

FIG. 1.—*Mola lanceolata*, from Noembing, Rhio Archipelago.

In such a case, it is difficult to believe that *Mola mola* would not be found with equal if not greater frequency over the same range. Perhaps Dr. Schmidt is in a position to suggest the true state of affairs. It would also be interesting to see the evidence for regarding the larvæ from the Sargasso Sea as those of *Mola lanceolata*. They were apparently not bred from the egg, and a very close series would therefore appear to be necessary to make certain of specific identity. In this connexion I would point out that I am handicapped by lack of literature, and have not been able to read Dr. Schmidt's detailed work ("Meddelelser fra Kommissionen for Havundersø-gelser", Serie Fiskeri, **6**, 1921), in which this latter point may be successfully met.

It seems probable that other specimens of *Mola lanceolata* have been taken and not put on record; duly authenticated notices of the capture of this species may help towards the solution of a problem of no little interest.

NORMAN SMEDLEY.

Raffles Museum, Singapore,
April 14.

'Powder-Post' Beetles

As a result of detailed observations supplemented by experiments, it can be stated that the actual food of the larvæ of *Lyctus* spp. (the powder-post beetles) is the *starch* present in the cells of the wood they infest. This starch is the main reserve substance of the plant, is present in the sap-wood only, and varies in quantity

from species to species of tree; these facts explain why it is that *Lyctus* attacks only certain kinds of timber and then only the sap-wood. The starch also varies in the growing tree from month to month, and is present in greatest abundance in winter, that is, in the felling season for 'hardwoods'.

It is found that if felled timber is kept 'in the log' sufficiently long (about a year), the starch disappears entirely from the sap-wood, and such timber is proved to be immune to *Lyctus* infestation. If, however, timber is converted soon after felling and then quickly dried, as in kiln-drying or steaming, etc., the starch remains in the sap-wood and such timber is liable to damage; no subsequent (seasoning) treatment can remove the liability.

By seasoning susceptible species of timber 'in the log' the pest can be controlled in a simple and inexpensive way, and its eradication from timber yards and wood-using factories is thus a practicable proposition. Damage costing many thousands of pounds a year can be saved and sap-wood made valuable, instead of being (as in oak) valueless for most purposes.

S. E. WILSON.

Royal Veterinary College,
Camden Town, N.W.1.

Lunar Periodicity in Reproduction

A NUMBER of living organisms, particularly marine animals, exhibit a lunar periodicity in reproduction.[1] Tides do not seem to be a causal factor in this phenomenon, and it has been difficult to understand how moonlight could be responsible, since the intensity of the light of the full moon is only about 1/500,000th that of sunlight.

Various authors in the past have pointed out that the light of the moon is partially polarised, and have suggested that polarised light is the responsible factor in lunar periodicity. This suggestion has been repeated in recent letters in NATURE.[2, 3] There are no known instances, however, of polarised light affecting organisms, and the little experimental work which has been done to test this has given negative results.[4, 5] Moreover, animals and plants receive very much more polarised light from the sky during each day than they receive from the moon. The following approximate calculation makes this clear.

The area of the hemisphere of sky and the area of the full moon are respectively 20,627 and 0·196 square degrees. The intensity per unit area of the light of the full moon may be taken as being about five times the intensity per unit area of the light reflected from the day sky. Therefore,

$$\frac{\text{Total flux from sky}}{\text{Total flux from full moon}} = \frac{20{,}627}{5 \times 0{\cdot}196} = 2{\cdot}1 \times 10^4.$$

The maximum polarisation of moonlight occurs at the first and third quarters,[6] so that the maximum total amount of polarised light from the moon is received shortly after the first and before the third quarter. The light intensity of the full moon is about nine times that of half moon, so that

$$\frac{\text{Total flux from sky}}{\text{Total flux from half moon}} = 9 \times 2{\cdot}1 \times 10^4 = 1{\cdot}9 \times 10^5.$$

The maximum percentage polarisation of moonlight[6] is 9. The maximum percentage polarisation of light from the day sky is 85, and applies to the light coming from the sky 90° from the setting sun.[7] Taking a value so low as one per cent for the polarisation of light from the sky during the day, we get:

$$\frac{\text{Total polarised flux from sky}}{\text{Total polarised flux from half moon}} = \frac{1{\cdot}9}{9} \times 10^5 = 2{\cdot}1 \times 10^4.$$

It is evident, therefore, that very much more polarised light is incident on the earth during the daytime than on moonlight nights.

Moreover, even if the polarised light of the moon could cause a reproductive rhythm, this would be a bilunar, not a lunar, cycle, for the maximum polarisation is at the first and third quarters.

Recent experimental work,[8, 9] however, on the influence of light on sexual periodicity in general, suggests a way in which moonlight might impose a lunar periodicity. In mammals and birds the length of the breeding season appears to depend in part on the daily number of hours during which the animals are exposed to light. Thus the moon may perhaps cause a lunar cycle in reproduction, not through its relatively small intensity of light as compared with that of the sun, but by the additional total number of hours of illumination per 24 hours at full moon, over and above a threshold light value. Only experimental work can test this hypothesis.

H. MUNRO FOX.

Zoological Department,
University of Birmingham,
June 3.

1 Fox, *Proc. Roy. Soc.*, B, **95**, 523; 1923.
2 Cunningham, NATURE, **129**, 543, April 9, 1932.
3 Philip, NATURE, **129**, 655, April 30, 1932.
4 Crozier and Mangelsdorf, *J. Gen. Physiol.*, **6**, 703; 1924.
5 Naviez and Rubenstein, *J. Biol. Chem.*, **80**, 503; 1928.
6 Lyot, *C. R. Ac. Sc.*, **178**, 1796; 1924.
7 Tichanowsky, *Phys. Z.*, **28**, 252; 1927.
8 Baker and Ranson, *Proc. Roy. Soc.*, B, **110**, 313; 1932.
9 Bissonnette, *Proc. Roy. Soc.*, B, **110**, 322; 1932.

A Genus of Ranunculaceæ hitherto Unrecorded for New Zealand

DR. W. A. SLEDGE, of the University of Leeds, who has recently brought home from New Zealand a collection of dried plants, kindly allowed me to look through his surplus stock of species belonging to *Ranunculus* and to take what flowers I liked for examination, as I am especially interested in the petal of this genus. One species, *Ranunculus tenuicaulis* Cheesem., appealed to me particularly on his information that he had noticed it when growing to have reddish flowers. Red colouring is unusual among buttercups.

On soaking out the two flowers available, I found on investigation that there was no sign of a double perianth. Thinking possibly that the sepals might have fallen, as these flowers were fully mature, Dr. Sledge supplied me with younger ones from his mounted sheet. These likewise showed a simple (monoseriate) perianth. Further, there was no indication of any nectary on the perianth segment or tepal, to use a non-committal term. The petal of *Ranunculus* is invariably characterised by the possession of such. The perianth, then, of this interesting plant is probably a petaloid calyx of five sepals. The small flower is borne singly on a short stalk arising from a whorl of three somewhat foliaceous bracts suggestive of the involucre of *Anemone*. The carpel is of a type quite unusual for *Ranunculus*, having a long spirally recurved style. The material at my disposal has scarcely been sufficient to ascertain definitely as to the exact manner in which the ovule is borne, but such evidence as has been obtained points strongly to a suspended rather than a basally attached one. Dr. Sledge has since satisfied himself that the ovule is suspended.

The examination of these flowers, then, certainly rules out *Ranunculus* as the genus to which this plant belongs, and suggests that the *Ranunculus tenuicaulis* of Cheeseman may be a species of *Anemone*. At any rate, it is a member of a Ranunculaceous genus hitherto unrecorded for New Zealand. So far, the only genera of this attractive family occurring in these islands are *Ranunculus* itself, by far the largest

with some 40 species, *Clematis* (9 spp.), *Myosurus* (one sp.), and *Caltha* (2 spp.).

The question naturally arises: How came the late Mr. T. F. Cheeseman to place this plant in the genus *Ranunculus*? Dr. Sledge in the letter below sheds some light on this. He hopes to secure more material of this interesting plant, and when it is available, we may then be able to determine exactly its systematic position. JOHN PARKIN.

Blaithwaite,
Wigton, Cumberland,
May 25.

I MAY perhaps supplement Mr. Parkin's interesting observations on *Ranunculus tenuicaulis* Cheesem. This montane species is rare throughout New Zealand and of most frequent occurrence in Otago, in which province I collected it. Single stations are also given in Cheeseman's "Manual of the New Zealand Flora" (Ed. 2, p. 442) for Canterbury and Nelson, whilst in the North Island the plant has been collected in the Tararua Mts. The plant was first collected by Cheeseman in 1883 at Arthur's Pass in the Southern Alps of Canterbury, and there are single authentic specimens of this gathering in the herbaria at Kew and the British Museum. We are indebted to the authorities at Kew and the British Museum for descriptions of these plants, both of which are in ripe fruit and lack perianth members, as does a second specimen at Kew collected by Kirk in the same locality a year later. In his original description of the species (*Trans. N.Z. Inst.*, vol. 17, 1884) Cheeseman writes, "Petals not seen"; and the inadequate references to the flowers in later descriptions in the "Manual", and particularly the absence of any reference to the very unusual and pronounced reddish colour of the perianth, would suggest that he never saw the plant in flower. His description of the achenes is more complete, and in the second edition of the "Manual" he adds the following note: "A very curious species, remarkable for the fusiform achenes and long spirally recurved styles". These "remarkable" facts are significant in view of Mr. Parkin's observations and the probable affinity of this plant with the genus *Anemone*. W. A. SLEDGE.

Botany Dept.,
University, Leeds,
May 25.

Reconstruction of an Indian Fossil Cycad

IN 1900, Prof. Seward showed, in a specimen found at Amrapara in the Rajmahal Hills, pinnate leaves resembling *Ptilophyllum cutchense* McCl. sp. organically attached to a cycadean stem of the *Bucklandia* type.[1] A *Williamsonia* flower discovered near the same locality a few years ago by Mr. G. V. Hobson of the Indian Geological Survey, and kindly placed at my disposal for description, proves to have belonged to the same plant as the *Bucklandia*. The stele of the peduncle shows that the wood is compact, as in the *Bucklandia*, and the structure of the bracts is identical in every way with that of the rhomboid leaf-bases preserved round the stem, which I have compared at the British Museum with kind permission of the authorities. There is also complete identity in structure with certain fragments of a *Williamsonia* flower, associated with another *Bucklandia* stem from Amrapara, described by Dr. N. Bancroft.[2] The flower is unisexual and ovulate; in structure it closely resembles *W. scotica* Sew., from the Jurassic of Sutherland.[3]

In a restoration which I have attempted, the plant has the habit of a miniature *Cycas*, with the surface of the stem covered by alternating zones of large and small rhomboid scars. The flowering shoots are shown projecting laterally from the columnar trunk, attached by an attenuated base and turned upwards, like the vegetative buds of the living genus. The name *W. Sewardiana* has now been proposed for the plant in supersession of the name *W. Sewardi* previously chosen,[4] as the latter name is preoccupied.

In view of our knowledge of the anatomy of the leaves, stem, and flower, this is now the best known species of *Williamsonia*. B. SAHNI.

University of Lucknow,
April 28.

[1] Jurassic Flora, "Brit. Mus. Cat.", 1900; "Foss. Plants", 3, 488, 489; 1917.
[2] *Trans. Linn. Soc.*, p. 76; 1913.
[3] *Trans. Roy. Soc. Edin.*, 203, 101; 1912.
[4] See Seward, "Plant Life", p. 356; 1931.

The *p*H Stability Region of Proteins and Osmotic Swelling

THE swelling of protein gels and tissues under the influence of acid or alkali is due mainly to osmotic forces set up on account of salt formation between the protein and the acid or base. Osmotic swelling always shows two well-marked maxima, one in the acid and one in the alkaline range, and it has generally been taken for granted that the *p*H-swelling curve should also show a sharply marked minimum corresponding to the iso-electric point of the protein. This misconception has arisen from the fact that the bulk of the work on the swelling and osmotic pressure of proteins has been done on gelatin and albumin, both of which

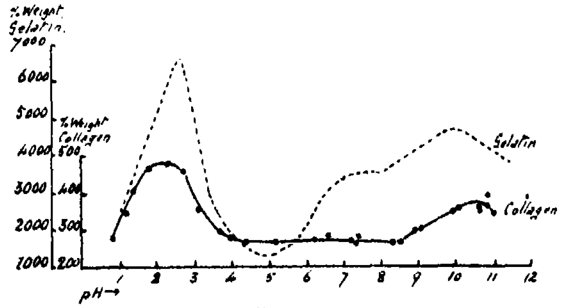

FIG. 1.

show sharply marked minima, and where it is not unreasonable to assume that the protein molecules are present without any orientation.

A very different state of affairs manifests itself, however, in protein structures, where there is evidence that the protein molecules are oriented on a definite system, generally lying parallel to each other, with the possibility of cross linkages. Examples of the effect of hydrogen ion concentration on swelling of proteins of this type show the appearance of a range of *p*H stability which becomes more emphatic with the development of a definite fibrous structure; muscle proteins, for example, have a stability range (roughly measured) of *p*H 5–7 or possibly 8.[1] The *p*H-swelling curve for collagen fibres is shown in the accompanying diagram (Fig. 1), together with the smoothed curve for gelatin. The contrast is striking, the curve for gelatin showing a sharp minimum at *p*H5 and that for collagen fibres a stability range of *p*H 4–8·5.

Keratin fibres (horse-hair) and silk fibres do not show osmotic swelling at any *p*H value, but begin to show swelling due to the breakdown of the structure by alkali at about *p*H 11–13. Speakman[2] has, however, shown that keratin fibres (wool) have a stability region against stretching forces of *p*H 4–8, and has

compared the stability range of wool keratin to the stability of protein aggregates described by Svedberg.[3] For serum albumin, the stability found by the ultracentrifuge extends from pH 4 to 9; for serum globulin from 4 to 8—this range is remarkably like the range of osmotic stability found in protein tissue.

Since osmotic swelling may, with considerable justification, be attributed to the formation of a colloidal ion by the protein, due to the formation of charge centres at the free amino or carboxyl groups, it appears that most native proteins have a tendency to form oriented aggregations so arranged that the attraction between the opposite charge centres is at a maximum. In other words, the molecules form cross linkages which are not readily opened up by slight changes in hydrogen ion concentration, and a stability region of pH becomes apparent. This molecular structure is not, however, stable towards all forces causing hydration of the protein. Collagen fibres resemble gelatin in showing marked swelling in salt solutions over the region between the iso-electric point and absolute neutrality. Keratin and silk fibroin do not show this salt action, possibly because the side spacings between the long protein molecules are so small that even the small molecules of electrolytes find difficulty in penetrating.

D. JORDAN LLOYD.

The Laboratories of the British Leather Manufacturers' Research Association,
May 25.

[1] D. Jordan Lloyd, *Proc. Roy. Soc.*, B, **89**, 277; 1917.
[2] NATURE, **127**, 665; 1931.
[3] *Kolloid Z.*, **51**, 10; 1930.

The Velocity of Light

IN NATURE for April 4, 1931, M. E. J. Gheury de Bray points out that the determinations of the velocity of light made in this century seem to tend towards smaller and smaller values the more recent the time of observation.

In this connexion the following remarks on the measurement of the standard metre in terms of the wave-length of the red cadmium line may be of interest. If L and f represent, respectively, the length of the metre and the number of wave-lengths, λ, contained in it, we may write

$$L = f_1\lambda_1 = f_2\lambda_2 \quad . \quad . \quad . \quad (1)$$

where the subscripts 1 and 2 refer to two different epochs. It is assumed that there is no intrinsic change in L between the two observations. If we also suppose that the frequency of the light, ν, has remained constant but that c has varied, then

$$\lambda_1 = \frac{c_1}{\nu},\ \lambda_2 = \frac{c_2}{\nu}, \quad . \quad . \quad . \quad (2)$$

whence

$$\frac{f_1}{f_2} = \frac{c_2}{c_1}. \quad . \quad . \quad . \quad (3)$$

Since the figures quoted by Mr. de Bray show a decrease in c of about 200 km./sec. between 1902 and 1928, an amount many times larger than most of the indicated probable errors, there may be a real difficulty. With this in mind, it is of interest to see what can be obtained from equation (3). So far as I am aware, there have been two determinations of the standard metre in terms of the red cadmium wave-length, and, quite recently, a similar measurement of the standard yard, by Tutton.[1] The observations on the metre, quoted by Tutton, are

Michelson . . .	1,553,163·50 (f_1)	1892
Fabry, Perot, and Benoit	1,553,164·13 (f_2)	1906

During the interval of fourteen years c would have changed by something like 1/3000, if its present apparent rate of decrease were constant. The difference in the two values of f is, however, negligible, and, moreover, Tutton's own measurements on the yard, when converted to the metre by a factor obtained by non-interferential methods, very strongly support the conclusion that the number of wave-lengths of a given line contained in a given length does not vary with the time.

Thus, taking all the observations at their face value, the situation is that $f_1 = f_2$ while $c_1 \neq c_2$. From these it follows that ν must depend on the time in a manner such that $c_1/\nu_1 = c_2/\nu_2$. Since in classical dispersion theory the index of refraction depends on the ratios of the frequency of the incident light to the natural frequencies of the charges in the body, this last relation might be expected to give rather curious results when observations are made from time to time with a prism spectrograph. None, however, has been reported.

If c does ultimately turn out to be constant, it will be important to investigate the discrepancies between the values hitherto published, in order that they may be used in the final mean. On the other hand, if c depends on the time, we may not unreasonably expect such a variation to appear in experiments other than those which give direct measurements of the velocity.

OLIN C. WILSON.

Carnegie Institution of Washington,
Mount Wilson Observatory,
May 10.

[1] *Phil. Trans. Roy. Soc.*, A, **230**, 293; 1931.

Climate of Southern Rhodesia

A NOTE on the "Climate of Southern Rhodesia" appears in NATURE of April 2, page 515, based on the Annual Report of this office for the year 1929–30. This notice of our work is much appreciated, but we regret that "E. V. N." has based a revival of the 'south-east trades' theory on the published rainfall maps.

Forecasts based on daily weather maps have been issued by this office for the last ten years. The general rains are of monsoonal character and are associated with the onset of north to north-easterly winds between the semi-permanent high of the Moçambique Channel and the equatorial low in the west.

Recent extension of the weather map has indicated that these winds traverse the tropical portion of the Indian Ocean. The humid north-easterly winds are interrupted from time to time by the invasion of cold air from the south-east in front of a high advancing up the east coast. The zone of discontinuity has marked frontal characteristics, and its passage is accompanied by squalls and thunderstorms, frequently succeeded by drizzle. These highs usually become stationary with their centres near 20° S. latitude, and give spells of fine weather, with light east winds. Apart from the precipitation at the discontinuity formed by the onset of the south-east winds, the rain associated with these winds is purely orographic and small in amount.

The presence of tropical cyclones near Madagascar is usually associated with a diminution of rain in Southern Rhodesia, apparently due to the interruption of the rain-bearing air currents, but a local cyclone which created havoc at Beira in 1929 was undoubtedly the prime cause of a period of heavy rain so far inland as Livingstone.

NOEL P. SELLICK
(Meteorologist).

Irrigation Division,
Department of Agriculture,
Salisbury, Southern Rhodesia,
April 23.

I HAVE read Mr. Sellick's letter about the rainfall of Southern Rhodesia with great interest. It was certainly not my intention to revive a theory of the origin of Rhodesian rainfall that has been disproved. My source of information was Kendrew's "Climates of the Continents" (1922). Kendrew makes a statement (p. 72 of that work) that implies that the monsoonal indraught in the South African summer is fed by the south-east trades, for he refers the moisture to evaporation over the South Indian Ocean. The case against this, it appears, rests upon a consideration of the trajectories of the inflowing air streams and not on the geographical distribution of the normal summer rainfall, for the ordinary diminution of rainfall (after elimination of the orographical factor) with distance from the coast would presumably be shown, whether the indraught were an eddy in the south-east trades or an eddy in a north-west current representing deflected north-east trades that have crossed the equator. Kendrew admits that in summer the north-east trades reach the north-west of Madagascar as north-west winds. The extended charts referred to by Mr. Sellick evidently show that these are then drawn into Southern Rhodesia during the monsoon. It is hoped that this important fact will be mentioned in future works on climatology. E. V. N.

Spectrographic Observations of Infra-Red Lines in the Auroral Spectrum

I HAVE read with great interest Prof. L. Vegard's recent communication[1] on this subject, in which he reports that in the auroral spectrum in the infra-red he has found two bands, a strong one at λ7883 A. and a weak one at λ8095 A., with sharp edges towards longer wave-lengths. Prof. Vegard considers that if the auroral green line is to be identified with the oxygen line at 5577 A., it is expected that other oxygen triplets, 7772-74-75, 8233-30-22, 7952-50-47, and 7481-79-77, will appear in this region, but none of these could be identified with the observed auroral lines. Taking into consideration the high intensities of these two bands, and the emission of the second positive bands of nitrogen in the auroral spectrum, he has interpreted these two bands as the appearances of the first positive bands of nitrogen with the special distribution of intensity.

In the course of investigations on the distribution of the intensity in the α-bands of active nitrogen, I have studied also the distribution of the intensity in the first positive bands in the case of passing an electric discharge of very weak current through nitrogen at low pressure and cooled with liquid air, and it was found that the bands due to the transitions from the initial levels which correspond to the vibrational quantum numbers 7 and 6 in the $B(^3\pi)$ state of nitrogen molecules are enhancingly emitted in the first positive bands. With reference to the results above described, the two bands which Prof. L. Vegard has found seem to be identified with the bands at 7896-80-58 ($7 \rightarrow 6$) and 8047-30-08 ($6 \rightarrow 5$) respectively in the first positive bands of nitrogen, though there are some differences in the wave-lengths. It may be considered that the experimental conditions above described are very close to those in the aurora with respect to pressure, temperature, as well as the conditions of weak excitation, and as a consequence of the Franck-Condon principle there will result fair concentrations of the excited nitrogen molecules in the vibrational levels corresponding to the quantum numbers $v' = (-11)$, 7 and 6 in the $B(^3\pi)$ state. Therefore it is expected that in the infra-red region the bands due to the transitions ($7 \rightarrow 6$) and ($6 \rightarrow 5$) will be emitted intensely, and these two bands will be identified with the bands which Prof. Vegard has reported and nicely interpreted ($n_1 \rightarrow n_2 = 7 \rightarrow 7$).

The detailed description of the experimental results will be published shortly elsewhere.

H. HAMADA.

Physical Institute,
Sendai, Japan,
May 13.

[1] NATURE, 129, 468, March 26, 1932.

Liquid Carbon Dioxide in the Depths of the Ocean

A PARAGRAPH in NATURE of April 23, p. 607, refers to a paper in which the Russian geologist W. Vernadsky states that carbon dioxide is in a stable liquid state in the depths of the ocean. He assumes that this may be the reason why there are no appreciable amounts of plankton below about two hundred metres. It must be remarked that the carbon dioxide is physically dissolved in the sea water, therefore the laws of gases do not apply. The pressure would only be of importance if springs of carbon dioxide exist on the bottom of the deep sea; in this case the carbon dioxide would issue as a liquid but quickly be dissolved by the water. According to the results of the *Meteor* expedition, it seems highly improbable that such sources of carbon dioxide are present in the ocean—at least, in the Atlantic.

However, the pressure causes an effect on the carbonic acid. The dissociation of this acid rather increases with the greater depths. The deep water is more acid than the shallower, provided the carbon dioxide content is the same.[1]

Concerning Vernadsky's conclusions, it may be mentioned that Hentschel[2] found considerable amounts of phytoplankton down to several thousand metres. Further, that the oxygen in the bladder of deep-sea fishes may be the result of a decomposition of liquid carbon dioxide seems quite impossible in view of the energy needed for this reaction.

H. WATTENBERG.

Institut f. Meereskunde,
Berlin, May 28.

[1] Cf. K. Buch, H. W. Harvey, H. Wattenberg, and St. Gripenberg, "The CO_2 System of Seawater", *Rapp. et Proc. Verb. Cons. Internat. pour l'explor. de la Mer*; 1932.
[2] *Ber. d. "Meteor" Expedition*, 2, Ges. f. Erdk. Berlin; 1927.

Meteorite Craters

THE very interesting article by Dr. L. J. Spencer on "Meteorite Craters", in NATURE of May 28, suggests a possible explanation of the fact that, while the bedding of the surrounding country may be horizontal, the strata exposed in the inner walls of the crater usually dip radially outwards from the centre.

The air photograph of the Cañon Diablo crater reproduced in the article bears a close resemblance to the well-known 'splashes' produced at the surfaces of armour-plate by the impacts of projectiles. The analogy between such 'splashes' and those of drops falling into liquids was pointed out by Roberts-Austen in *Fielden's Magazine* of August 1899.

It may be of interest to recall that A. M. Worthington was the first to synchronise photographic records with the movements occurring during the 'splash of a drop'. His classical work formed the subject of a discourse at the Royal Institution in May 1894.

S. W. SMITH.

Royal Mint,
London, E.C.3,
June 6.

Research Items

British Hanging Bowls.—In *Antiquity* for June, Mr. T. E. Kendrick has published a study of the hanging bowls of bronze with special reference to their position in the cultural history of Britain. Hanging bowls, already known in Britain in La Tène times, returned into fashion in the second half of the Roman period. An approximate date of A.D. 400 is suggested for the hiding of a hoard found at the Romano-British settlement at Irchester. The most decorative bowls are those fitted with escutcheons in the form of enamelled discs. They may be grouped under three sub-headings: (i.) The 'Romanising' series; (ii.) the 'ultimate La Tène' series; and (iii.) the 'developed trumpet-pattern' series. In the Romanising series, the escutcheons show the inspiration of classical ornament and come down possibly to a date not later than 500 B.C. The 'ultimate La Tène' series is the work of craftsmen who were still resolutely Celtic, and had no sympathy with Roman and contemporary continental design. They represent the continuation of the native enamel work of the north. The Barlaston bowl and the Northumberland escutcheons, which belong to this class, cannot be later than A.D. 300. The contrast with class iii., the 'developed trumpet-pattern' series, is very striking. Here the work is primarily concerned with the modifications of the late Roman pelta trumpet-patterns, which are transformed with all the grace of the British artist. These decorative designs later became the stock-in-trade of the illuminator; and it is suggested that they are not the renaissance of an ancient Celtic art, but an independent Celtic experiment which developed a borrowing from late Roman art. Although the bowls are for the most part found in Saxon graves, they were loot; and the Saxons probably contributed nothing to their manufacture.

Palæolithic Art in the Grotte d'Isturitz.—M. le Comte Réné de Saint-Périer has described (*L'Anthropologie*, **42**, Nos. 1-2) two remarkable examples of palæolithic art which have been discovered in the course of excavating the inner chamber of the Grotte d'Isturitz (Basses Pyrénées). They are derived from a lower Magdalenian stratum without harpoons, above which are, possibly, two Magdalenian strata in which harpoons appear. One of the objects is a sculptured bear in limestone, 51 mm. high by 20 mm. thick. Great care has been given to the proportions of the figure. The limbs have been broken off by an ancient fracture almost level with the body. The sculpture is charming in its correct representation of the characteristic modelling, attitude, and expression of what is clearly *Ursus arctos* and not *Ursus spelæus*. The second object is of bone, 120 mm. by 20 mm. by 2 mm. thick. The ends are broken off. It is engraved on both sides. On one side is a bison of fierce aspect, realistically engraved to show the distribution of the hair. Two harpoons or barbed javelins are in its flank, and two columns of hot breath issue from its nostrils as it follows another bison, of which the hind-quarters have just survived the fracture. On the other side, two crudely engraved human figures, male and female, appear, which in their relation one to another are unique in palæolithic art. The woman, whose head is broken off, is fat but not enceinte. Hair is shown freely distributed over the abdomen, thighs, and the one breast visible. Bangles encircle one ankle; a barbed javelin head appears on the right thigh; and the arms are raised as if in prayer. The man, of whom half remains, is in the same attitude with arms upraised and face looking up towards the woman above his head. He wears necklaces and bracelets.

Identical Twins reared Together.—The studies of Dr. H. H. Newman on twins reared apart (see NATURE, May 7, p. 692) are to some extent supplemented by Mr. Harold D. Carter's account (*J. Heredity*, vol. 23, No. 2) of identical twins reared together. In Case 1—boys of fourteen years of age—one of them reads more and appears somewhat brighter; but it is not clear whether he is brighter because he reads more, or reads more because he is brighter. The Siamese twin girls aged fourteen years studied by Dr. Helen Koch were found to differ distinctly in intellect and achievement, but the differences are less than in most twins. Such differences are regarded as innate and not environmentally produced. In Case 3 (brothers of sixty years) the twins were more unlike than in Case 2 (sisters of thirty-eight years), although the similarities of environment were greater in the former case. In Case 2, the difference in ability was in favour of the twin with less favourable environment, again suggesting that a difference in mental endowment was determined internally rather than externally. In all these cases the twins were extremely alike, often mistaken for each other, and their finger patterns almost or quite identical.

Control of Leather-Jackets.—Among other articles of practical value and interest in the sixth issue of the *Journal* of the Board of Greenkeeping Research is one by R. B. Dawson, which deals with the question of the control of leather-jackets, the larvæ of *Tipula paludosa* or daddy-long-legs, which may be very destructive on golfing turf. The subject is introduced by an account of the life-history and habits of the insect, knowledge of which is essential if suitable control methods are to be found. For small, level areas, the practice of spreading tarpaulins or rubber mats overnight on grass which has been soaked with water often proves successful, as the larvæ collect at the surface. For larger areas, applications of a chemical larvicide is more practicable, and a 64 per cent emulsion of orthodichlorobenzene is specially recommended. This has proved a thoroughly trustworthy method of control, and only temporarily discolours the grass. Full instructions for making and using this emulsion are supplied, the cost of the treatment being 8*s*.-12*s*. per 500 sq. yards. Other methods involving the use of materials such as naphthalene, paris green, ammonia solutions, etc., may also be effective in controlling the pest, but they are less unreservedly recommended, as they are apt to be unreliable, and in some cases have poisonous properties.

Characteristics of Home-grown Timbers.—With the introduction of research into the mechanical and physical properties of timbers, it has been necessary not only to standardise the meaning and application of technical terms and the methods to be followed in the tests, but also to compile and publish the results in rather complicated tabular statements. In order to place this information in a form more readily accessible to those who wish to have a general comparison of our home-grown timbers in their relative strengths as developed in various types of construction and manufacture, the Forest Products Laboratory has issued *Bulletin* No. 12, entitled "Some Characteristics of Home-grown Timbers" (pp. v + 11 + 9 plates. London: H.M. Stationery Office, 1931. 2*s*. net). The publication deals with the characteristics of eight home-grown hardwoods and five softwoods: oak, ash, beech, common elm, Dutch elm, wych elm, chestnut, and poplar (*P. serotina*); Corsican pine, Douglas fir, European larch, Scots pine, and silver

fir. The strength properties of the species are compared by means of diagrams in which the height of a column denotes the degree of the property attained by the particular timber, as compared with the same property in home-grown oak; these diagrams are explained by notes, which give not only the applications of the various strengths and other properties depicted, but should also afford considerable assistance in the selection of timber for a given purpose. Besides the general comparisons above mentioned, there are graphs which show the influence of the specific gravity of a timber upon its relative strength, as well as diagrams indicating the relative shrinkages which take place in the timbers. These last are of particular interest in the case of woods for panelling, flooring, patterns, and other uses where shrinkage and the 'working' of the timber with change in atmospheric humidity are of considerable importance.

Earthquakes, Fisheries, and Flower Fall.—Prof. T. Terada has shown that there exists a curious relation between the numbers of earthquakes in the Idu peninsula and the numbers of fishes caught near the northern end of Sagami Bay (*Proc. Imp. Acad. Tokyo*, vol. 8, pp. 83-86; 1932). During the spring of 1930, swarms of earthquakes occurred in the neighbourhood of Ito on the east coast of the peninsula (NATURE, vol. 126, pp. 326, 971). It was found that the epochs of abundant catches of horse mackerel (*Caranx*) at the Sigedora fishing ground coincided very nearly with those of the earthquakes. This result led Prof. Terada to compare the numbers of fishes caught in the six years 1924–29 with the numbers of felt and unfelt earthquakes in and near the Idu peninsula. For the year 1928, the parallelism of the two curves was very close, though in other years it was less conspicuous. During 1928, the curve representing the numbers of immature tunny (*Thynnus*) caught shows a remarkable similarity with the horse mackerel and earthquake curves. In another paper (*Bull. Earthq. Res. Inst.*, vol. 10, pp. 29-35; 1932) Prof. Terada points out that, though the daily numbers fluctuate, the time-distribution curve of the Ito earthquakes resembles on the whole the probability curve, and he shows that the daily number of falls of camelia flowers follows a similar statistical distribution.

Meteorology of the North and South Atlantic.—Continental meteorologists have in the past played an important part in the collection of information about the weather over the Atlantic. The long series of daily synoptic weather maps for Europe and the Atlantic prepared by the Danish and German Admiralties before the War were for many years without rival for completeness, and have been of constant assistance to the forecasting staff of the Meteorological Office, Air Ministry, in the study of large scale air movements and their effect upon British weather. The last section of a new contribution, of a more statistical nature but dealing with an almost equally large area—namely, the North and South Atlantic—has just been received. It has been compiled under the direction of Prof. E. Van Everdingen, the director of the Dutch Meteorological Service, and summarises about seven million observations of oceanic current, wind, barometric pressure, temperature, and cloud, covering the three months September, October, and November for the years 1870–1925, the other quarters having already been dealt with. It takes the form of a series of large charts with explanatory matter and tables (*Pub.* No. 110, Koninklijk Nederlandsch Meteorologisch Institut). It is scarcely necessary to say that such a compilation is of immense value to those engaged in a study of world weather, and that it will be a mine of information for future compilers of climatological handbooks and treatises. It includes detailed studies of the more important disturbances which are of danger to navigators of the Atlantic, such as the cyclonic depressions of the North Atlantic, the West Indian hurricanes, and the 'tornadoes' or storm squalls of the West African coasts. These last, it should be mentioned, differ greatly from the American tornadoes, which are much more violent, but fortunately also individually affect much smaller areas and are in the main land phenomena outside the scope of this work. Assistance in the supply of data has been given by the French, German, and English meteorological services; this is therefore the concluding section of a great international undertaking.

Vacuum Distillation.—In a paper on vacuum technique (*J. Franklin Inst.*, Feb. 1932), Dr. K. Hickman of the Kodak Research Laboratories has directed attention to the serious errors which may occur in the measurement of the saturation vapour pressure of liquids when that pressure is of the order of a millimetre of mercury. Unless the vapour pressure is measured close to the thermometer which gives the temperature, the correction for the drop of pressure from thermometer to manometer becomes of the order of the pressure to be measured. Dr. Hickman enlarges the head of the rectifying column, places the thermometer in the enlargement, and either measures the pressure there directly or by the aid of a column of the condensed liquid in a U-tube between the enlargement and the manometer. With this arrangement, he finds that the relation between log (pressure) and the reciprocal of the absolute temperature continues to be linear down to very low pressures.

Spectrum of Lithium Hydride.—A further analysis of this spectrum, which is one of considerable complexity, is given by G. Nakamura and T. Shidei in the *Japanese Journal of Physics* (**7**, p. 33). In their previous work, a large number of faint lines were not classified; in the present investigation, it has been found possible to include many of these in a band system which is attributed to the hydride (Li^6H) of the lighter and rarer lithium atom, but the very curious feature emerges that the relative intensities of the lines associated with Li^6 and Li^7 respectively vary with the conditions under which the spectrum is taken. This is in accord with Dempster's work on lithium with the mass-spectrograph, but not with that of Bainbridge. This spectrum has the further point of interest that it arises from two of the lightest atoms, so that it is not impossible that it may serve to check a quite full quantum theory of their combination; the theory of the normal state of the molecule has already been developed in some detail by Hutchisson and Muskat in the first May number of the *Physical Review*.

The Electron Microscope.—It has been known for many years that a divergent pencil of electrons can be refocused by a magnetic field. More recent investigations, which are summarised by E. Brüche and H. Johannson in *Die Naturwissenschaften* (May 20), have shown that an electric field can act similarly, and, in fact, that a complete system of electron-optics exists, with reflecting and refracting surfaces in the ordinary sense replaced by regions of field acting upon moving electrons. Brüche has demonstrated the action visually by photographing beams of electrons passing through 'electron-lenses' in gas at low pressure. In this article an account is also given of an electron-microscope which is likely to be of use technically; it is constructed much on the principle of an ordinary microscope, but with electron lenses, and shows a much enlarged image of a small electron-emitting

surface by the fluorescence of the points of impact of electrons which have passed through the 'microscope' on to a screen. The whole arrangement is like a small optical bench set up in a vacuum vessel. Two examples of its application are given: the first, a 150-fold enlargement of a badly coated oxide cathode, showing clearly the patchy nature of the active surface, which could not have been inferred with such certainty from an ordinary optical study; and, secondly, a set of enlargements (× 65) showing the migration and final disappearance of the active centres on an overheated coated cathode. It would appear to be possible in principle, although scarcely in practice, to obtain pictures of the electron-emitting areas on the surface of the sun from experiments on the streams of charged particles which produce the aurora.

The Wassermann Test.—Many variations of the Wassermann test have been described, with the view of increasing its sensitiveness and rendering it more specific, thus eliminating the doubtful reactions, which are of no value to the clinician. E. J. Wyler has recently described an improvement in his routine test, by which more accurate results can be obtained (Reports on Public Health and Medical Subjects, No. 67. London: H.M. Stationery Office, 1932. 4*d*. net). In the test, the suspected serum, previously heated to 55° for 30 min. to inactivate complement, is mixed with complement (guinea-pig's serum) and antigen (alcoholic human heart extract, 3 parts, with 2 parts of a 1 per cent alcoholic solution of cholesterol) and incubated at room temperature for 30 min. and then at 37° for 30 min. A standardised suspension of sheep's red blood cells sensitised with at least six doses of hæmolytic immune body is then added; hæmolysis occurs quickly when the suspected serum does not come from a case of syphilis, but is absent or incomplete when the patient has suffered from syphilis which has not been completely cured—in other words, the Wassermann test is positive. In all tests, control tubes are put up containing serum and complement but no antigen: lysis of the sensitised red cells should be quick and complete, when added at the end of the preliminary incubation, in the presence of three minimal hæmolytic doses of complement. The variations in the method concern the amounts of complement, antigen, or serum added and the type of antigen used. The author has found that the greatest sensitiveness is attained when the amount of serum is increased from three up to five times that normally used, whilst variations in the quantities of the other reagents gave less satisfactory results. 20 per cent of sera which were negative or doubtful by the routine test gave a definite positive response with the new method. In non-syphilitic sera, there were no false positives and only 2·6 per cent were doubtful: with the ordinary test, 9·3 per cent were doubtful. The new method is also more sensitive than the flocculation or Sigma test, which itself is more sensitive than the routine Wassermann test.

Astronomical Topics

Two New Comets.—A telegram from the I.A.U. Bureau, Copenhagen, announces the discovery of a new comet by Mr. Newman, who gave the following position for 1932·0:

U.T.	R.A.	N. Decl.
June 20d 4h 49·4m	15h 37m 16s	7° 56′

Daily motion, −2m 8s, +44′: Magnitude, 13·0

From observations on June 1, 7, and 20, Whipple and Cuningham have determined the following elements:

$$T = 1932 \text{ Sept. } 27 \text{ U.T.}$$
$$\left.\begin{aligned}\omega &= 73^\circ\ 50'\\ \Omega &= 244\ \ 50\\ i &= 76\ \ 50\end{aligned}\right\} 1932{\cdot}0$$
$$q = 1{\cdot}57$$

The following ephemeris is for 0h U.T.:

	R.A. (1932·0).	Decl. (1932·0).
June 30	15h 20m	+14° 0′
July 4	13	16 10
8	15 8	18 10

The following observations have been made by Dr. W. H. Steavenson with his reflector at West Norwood. Equinox 1932·0:

	R.A.	Decl.
June 21d 23h 9·7m	15h 34m 3·1s	+ 9° 4′ 42·6″
22 23 9·5	15 32 10·2	+ 9 43 48·0
25 0 19·3	15 28 26·5	+10 51 16·9

The B.D. position of the comparison star, B.D. + 9° 3075, was used. The comet preceded it by 1·0s, and was 7′ 19·1″ north of it. The diameter was 1′, and there was a nearly stellar nucleus of magnitude 12. The approximate daily motion indicated is about −1m 41s, +38′. The comet is well placed for observation.

A Reuter's telegram from Wellington, New Zealand, announced the discovery of a comet of the 10th magnitude by the New Zealand Government Astronomer; the message was dated June 23, but the discovery was presumably on June 22 by U.T.

R.A. 0h 15m decreasing.
S. Decl. 84° 36′ decreasing.

This makes the seventh cometary discovery of the year, including the van Biesbroeck object of March 6, which was not seen again. Two of the seven (Grigg-Skjellerup and Kopff) were the returns of periodic comets; the others appear to be new comets.

The Coming Total Solar Eclipse.—An article by Dr. A. V. Douglas (*J. Roy. Ast. Soc. Canada*, May–June) gives information about the arrangement of parties to observe this eclipse, and suggests how amateurs can help. Observations of the exact limits of the path of totality are suggested; this was satisfactorily carried out in the eclipse of January 1925; also observations of the shadow-bands, of the fall of temperature, and of the degree of illumination during totality (by seeing at what distance small type can be read). It is also suggested that wireless experts may study the effect of the eclipse on radio-transmission. Dr. Douglas gives a list of coming totalities; but, curiously, as in several lists, the favourable eclipse in Norway on July 9, 1945, is omitted; this is a return of the British eclipse of 1927, but with a higher sun and longer totality. Prof. C. A. Chant, in the same journal, gives details of the location of the various parties of observers. Dr. J. Jackson and Mr. C. R. Davidson from Greenwich, with Dr. Knox Shaw, are going to Parent, north of the St. Lawrence; Prof. F. J. M. Stratton to Magog, on the south side of the River; Profs. A. Fowler and H. Dingle will observe from McGill University, near the edge of the belt of totality. A party from the Royal Astronomical Society will go to a station in Maine. Nearly all the great American observatories are sending parties, and others are going from Japan and Pulkovo. Given fine weather, it should be one of the best observed eclipses on record. A map of the portion of the track from the St. Lawrence to the Atlantic is given in the B.A.A. Handbook for 1932.

New Methods of Research in Aeronautics

THE twentieth Wilbur Wright memorial lecture, delivered before the Royal Aeronautical Society by Mr. H. E. Wimperis, on May 26, under the above title, is of twofold interest to scientific readers. It gives an account of the work now in progress in aeronautical research. It also includes a more abstract discussion upon the aims of aeronautical research in Great Britain, the difficulties that confront it—not the least of which are those of finance—and the methods by which it is hoped they will be overcome.

Mr. Wimperis began by commending the methods of the Wright brothers as being the soundest in scientific research. They "made thousands of tests . . . and tabulated thousands of readings". Few persons actually engaged in research will quarrel with that commendation. The paper then describes the organisation of aeronautical research in Britain, and pays tribute equally to the progress made by the scientific workers and to the aircraft industry's ability in utilising information so obtained. Mr. Wimperis scarcely gives full credit to Britain for its relative contribution to the world's aeronautical knowledge; in fact, he more than once apologises for the inadequacy of the equipment, both in use and proposed. It is hoped to be able to use this limited amount of apparatus for the unhindered solution of various problems, by skilful adaptation, and extending results so obtained upon a basis of mathematical and physical reasoning.

The new British compressed air tunnel will be able to obtain a Reynolds number 1·93 times that of the only other one in existence in the U.S.A., by working at an air pressure of 25 atmospheres. The solution of many of the problems met in the course of the development of this apparatus has been very materially helped by the full and free communication of all available information from the National Advisory Committee for Aeronautics in America. Incidentally, the policy of delaying the building of this tunnel until the U.S.A. Committee had fully explored theirs has been fully justified, and the truly international aspect of scientific research, when unhampered by political affairs, is emphasised.

The large wind channel to be erected at the Royal Aircraft Establishment at Farnborough is to be only 24 ft. diameter, against the 60 ft. × 30 ft. cross section of a similar one in America, and will use 2000 h.p. for air propulsion, as compared with 6500 h.p. in the large American tunnel. It will thus be cheaper both in first cost and running expenses. A 24-ft. tunnel can be used to investigate all problems that must inevitably be so done, that is, those incapable of being attacked by direct full scale experiments during flight. These are all connected with the central part of an aeroplane, principally the cooling of engines, resistance of the body and its parasitic parts, and the investigation of airscrews. Problems upon the behaviour of the actual wing structure can be, and have been, successfully measured in full scale flight on a special Parnall research monoplane, and such results can be added to those found in the tunnel for the more complex parts around the body.

A vertical wind tunnel for the investigation of spinning is also described. The air in this moves upwards, so that the spinning model, while falling relative to the air, is actually kept in the plane of observation and measurement by the operator. These experiments raise extremely complex problems upon the validity of transferring results from models of one size to another, or comparing results at different speeds, because of differences in mass, moments of inertia about various axes, etc. The effect of the sudden movement of control surfaces is reproduced by a delay action mechanism incorporated in the model.

The visual examination of air flow has obvious uses in aeronautical research. This is accomplished by the introduction of smoke from titanium tetrachloride for slower speeds. For higher speeds, shadowgraphs are taken from air heated by passing it across an electrically heated wire and viewing the model in its wake, either stroboscopically or photographically. When conditions are analogous, water can be used, and the motion examined either by watching illuminated oil bubbles or by focusing a microscope upon 'objects' in the water.

Experiments upon the suppression of noise are of interest not only for themselves, but also for the necessary development of the technique of the measurement of noise in 'decibels'. Considerable progress has been made in the insulating of the interior of an aircraft cabin from noise, but not so much upon the suppression of the noises at the source.

An ambitious programme of work on flying boat hulls and floats is outlined for the new tank at the R.A.E., Farnborough. Although the size of the tank is being limited, it is hoped to investigate all that is necessary by examining the behaviour of the model during the inevitable acceleration and deceleration in each run. It so happens that these are the two periods of greatest interest to designers, as the only parts of a seaplane's normal travelling life on the water are spent in either of these operations. Here again there will be considerable mathematical difficulties concerned with problems of mass, acceleration, and dynamical similarity.

The address concludes with a tribute to all those who have been concerned with the work of producing and handling machines for the Schneider contest. Mr. Wimperis expresses his satisfaction that these competitions have now automatically ceased, as the risk to the flying personnel was out of all proportion to the value of any results likely to be obtained from the mere further increase of flying speed alone. Nevertheless, the value of the technical progress that has been made in this respect is not to be underestimated.

Early Maya Culture in Northern Yucatan *

COBÁ, if only on account of its size, is one of the most important centres of culture in the Maya area of Central America. If, and when, its ruins are excavated, it is not improbable that it may prove crucial in the solution of a number of obscure problems connected with early Maya colonisation in northern Yucatan. Since its ruins were discovered in 1926 by Dr. T. W. Gann—it was not then known that it had been visited by Teobert Maler in 1891—five further expeditions of the Carnegie Institution have been engaged in exploration and survey work on the site.

Cobá, which is situated in the Mexican province of Quintana Roo in the north of the Yucatan Peninsula,

* A Preliminary Study of the Ruins of Cobá, Quintana Roo, Mexico. By J. Eric Thompson, Harry E. D. Pollock, and Jean Charlot. (Publication 424.) Pp. vii+218+18 plates. (Washington, D.C.: Carnegie Institution, 1932.)

about 100 miles east of the ancient Maya city of Chichen Itzá, and has the largest assemblage of buildings, with the exception of Tikal, in the Maya area, is one of the few sites of which the ancient name is still known to present-day Indians. Vestiges of ancient cult and ritual still linger on before its stelæ; while the deities of Cobá are venerated in bee-keeping and first-fruit ceremonies in distant villages, where the inhabitants assuredly have no knowledge of the present-day ruins of Cobá.

The site of Cobá was especially favourable for Maya colonisation, owing to the propinquity of an ample supply of surface water in a chain of lakes, and a plentiful rainfall, which fostered the growth of vegetation and the pursuit of agriculture.

The area which has been mapped up to the present covers 9 km. from north to south and 5 km. from east to west.

To the south the ground is still unexplored, and more ruins may yet be found there. Of the surveyed area, the northern part is literally covered by ruins. Between the main groups of Cobá and Nohoch Mul there is an almost unbroken succession of mounds, culminating in a group of considerable importance associated with Nohoch Mul. The shores of Lakes Cobá, Macanxoc, and Sacakal are surrounded by mounds which, excluding those of the last-named lake, form one great site, 3·5 km. by 2 km.—certainly one of the largest in the Maya area.

One of the most striking features of Cobá is the network of artificially constructed raised roads connecting the various groups about the lakes and running off in all directions to distant sites. One of these leads to Yaxuná, a distance of 100 km., terminating only 20 km. from Chichen Itzá. These roads are raised above ground-level and, for the most part, run perfectly straight. They are built of vertical slabs of roughly dressed stone, with an inside fill of large stone, covered with smaller stone. A fine plaster surface has now weathered away.

Broadly speaking, the ruins of the Cobá district fall into two classes of construction, a superior and an inferior, which, while not differing radically, exhibit certain variations in quality of workmanship and design. A preponderance of the buildings shows a closely connected court type of assemblage with a fixed scheme of orientated groups. The Macanxoc groups, however, abandon the orientation. Such compact assemblage finds its most common expression in the Peten region of Guatemala at Tikal, Nahum, and similar sites; while Uaxactun shows a tendency to separate groups, though still with an orderly scheme of arrangement of buildings, definitely related to one another. Notwithstanding the difficulty of drawing parallels between Cobá and other areas, there are certain distinctly marked affinities with the 'Old Empire' centres to the south, which is borne out by the analysis of the art of Macanxoc, for which Mr. Jean Charlot has been responsible. At the same time, there is sufficient evidence of independence in development, especially in the unique character of the complicated system of artificially made roads, to suggest a long period of growth locally, and even possibly several occupations.

At one time or another, no less than fifty monuments have been discovered at Cobá. Of these, twenty-four are carved, twenty-three being stelæ and one an altar. The stelæ at Cobá and Macanxoc are placed in 'shrines'—stone structures consisting of a platform with back walls and short projecting side walls. Structures of this type have not been reported from any other Mayan site. It is possible that they were roofed over with thatch.

Some of the stelæ are dated in the Maya notation. Of these, the earliest is of some importance in its bearing on the spread of Maya colonisation into northern Yucatan. Hitherto it has been held, on the authority of a statement in the Book of Chilam Balam, that Chichen Itzá marks the first Maya intrusion into the area. This is dated at an equivalent in the Christian system of A.D. 452; but a dated monument at Cobá gives a date equivalent to A.D. 353, making this site at least a hundred years earlier; while the evidence of the development of style in architecture and art suggests that the original settlement was considerably older. A series of dates is now known from the three cities of Tuluum, Ichpaatun, and Cobá, ranging from A.D. 314 to 353, which points to a movement along the east coast of Yucatan, of which the terminal was Cobá, and the place from which it originated in the 'Old Empire' area of Peten, possibly at Naranjo, though on the evidence of affinities in art, Mr. J. Charlot thinks it possible that the site of origin may still await discovery.

Sunspots, Planets, and Weather

ONE of the most interesting problems of meteorology is the relation between sunspots and terrestrial weather. In most parts of the world, including the British Isles, the relation is too complex to be readily demonstrable, and the number of unknown factors too great for it to be of use in forecasting, but in a few areas, for one reason or another, the control by sunspots becomes dominant. Mr. Inigo Jones, Director of the Bureau of Seasonal Forecasting in Queensland, believes that Australia is one of these areas under solar control, and in a recent presidential address to the Queensland Astronomical Society* he quotes a number of examples.

Mr. Inigo Jones carries the problem a stage further, however, seeking beyond sunspots for their causes. The sunspot cycle, striking as it is, is not perfectly regular, and the dates of maxima and minima cannot be forecast exactly. He believes that this cycle is caused by the movements of the planets; it is dominated by Jupiter, which has a periodicity of 11·86 years, but irregularities are caused by Saturn and to a less extent by Uranus and Neptune, and these introduce additional cycles which reduce the average length to 11·1 years. Hence he seeks for the explanation of abnormal weather not only in the sunspots themselves but also in the conjunctions of the planets. Especially important is the conjunction of all four, which occurs at intervals of 164 years and is often associated with world-wide climatic disturbance and severe famines.

The way in which sunspots operate is still a mystery, but there are many indications that the greatest effects take place high in the atmosphere, in the ozone layer, the conducting layers, and the auroral zone, and the surface effects may be of a secondary nature only. Mr. Inigo Jones describes a possible mechanism as follows: "Cyclones to which our heaviest rains are attributable are caused by discontinuities between air masses having different temperature and moisture contents, and it is clear that any upper air changes must accelerate such differences, and further, the fact that sunspots by their emanations disturb the upper air and so suddenly intensify these differences, shows easily how it is that the effect is produced, and at the initiatory or terminal stage of each sunspot's visibility". More prolonged effects may take place through the action of ozone, and investigations which

* "Seasonal Forecasting." Brisbane, 1931.

are now being made into the relations between solar radiation and ozone should throw a great deal of light on the effect of sunspots on weather.

The problem is complicated by terrestrial effects, such as the lag in changes of world temperature caused by the masses of polar ice and by the movements of powerful ocean currents, or the disturbing effects of great volcanic eruptions. All these factors will need to be taken into account before long-range forecasts can attain a really effective precision, but Mr. Inigo Jones gives a number of examples to support his view that in Australia at least the major control of weather is exerted by the sun.

Canned Fruit and Vegetables

THE processes that made the preservation of fruit and vegetables possible were discovered in France more than a century ago, but although numerous canning factories have been in operation in several European countries, America, and parts of the British Empire, it is only during the last ten years that any have been built in England. However, 53 such factories were in operation in this country by 1931.

The quantity of canned fruit imported into England has shown an enormous increase in recent years. In view of this greater demand, the home industry has every prospect of success, provided the grower will produce the right type of fruit and vegetable. To meet this need, the Ministry of Agriculture has published an illustrated bulletin (No. 45) entitled "Fruit and Vegetable Production for Commercial Canning" (London: H.M. Stationery Office, 1*s*. 3*d*.).

Plums are by far the most important tree fruit for canning purposes, the use of cherries being somewhat restricted owing to the tendency of the juice to act on the metal container and the difficulty of finding a suitable variety. As regards the commonly grown soft fruits, the majority may be successfully canned if firm, clean fruit is selected. Up to the present, peas are the only vegetable that has been canned in any quantity, but the possibilities of extending the industry to include other vegetables are indicated.

Production for the cannery is an entirely different proposition from production for the fresh market, and it is essential that the grower should recognise this from the start. On the whole, it would seem most suited to large-scale producers with mechanical methods of cultivation, as regular, standardised consignments are required and costs must be kept as low as possible. From the long experience obtained in other countries, the desirability of contract growing is indicated. Various methods of this system are discussed, but it is evident that special arrangements will need to be worked out to meet the particular requirements of the different crops. Some such methods should, however, do much to promote the development of the industry and give confidence to the growers.

Standardised Preparations of Vitamins A and D

WE are glad to note that British manufacturers have taken full advantage of the recent striking advances in our knowledge of the fat-soluble vitamins A and D and have now available for general clinical use standardised preparations of these highly important substances. The isolation of calciferol (vitamin D) by Dr. Bourdillon and his collaborators has been followed in a remarkably short space of time by its preparation on a commercial basis by British Drug Houses, Ltd., who are to be congratulated on the rapidity with which they have translated a delicate laboratory process to a works' scale. This firm now supplies, under the name of Radiostol Solution and Radiostol Pellets, pure crystalline vitamin D. The solution, the activity of which is such that one fluid ounce is equivalent to fifty fluid ounces of cod-liver oil, is a tasteless preparation of the pure vitamin in oil, while the pellets contain it incorporated in cocoa butter, one pellet being equivalent to a full adult dose of cod-liver oil.

Another physiologically standardised vitamin D product, sold under the brand name of Ostelin, emanates from the Glaxo Laboratories (Joseph Nathan and Co., Ltd.). This preparation, which was originally manufactured in 1924 from cod-liver oil but is now prepared by the carefully controlled irradiation of ergosterol, is also supplied in both liquid and tablet forms. Ostelin liquid, which is standardised to contain 5000 international units of vitamin D per c.c., is tasteless and miscible with water, and can therefore be dispensed in pharmaceutical mixtures. The tablets contain, in addition to 500 units of vitamin D each, neutral calcium glycerophosphate.

More recently the Glaxo Laboratories have also put on the market, under the brand name of Adexolin, a mixed preparation of both vitamins A and D in proportions normal to cod-liver oil. Adexolin is available both as liquid and capsules. The special feature of the liquid, a fluid oz. of which is equivalent in both vitamins to 20 fluid oz. of good cod-liver oil, is that as a result of a special process it is largely free from the objectionable taste of ordinary fish-liver oil concentrates. The capsules have been designed to allow the administration of larger quantities of the two vitamins than is necessary for infants. The prophylactic dose for adults is usually 1–3 capsules per day, but in cases of acute septicæmia complicated by high febrile conditions, so many as 24 capsules per day can, we are informed, be administered with highly favourable results.

University and Educational Intelligence

BIRMINGHAM.—The degree of D.Sc. has been awarded to T. L. Ibbs for various papers on thermal diffusion and the form and field of force of the carbon dioxide molecule and allied subjects.

LONDON.—Mr. J. L. S. Hatton, principal of East London College, has been elected vice-chancellor for 1932–33 in succession to Dr. J. Scott Lidgett, whose term of office expires on Aug. 31. Dr. W. R. Halliday, principal of King's College, has been appointed deputy vice-chancellor for the same period in succession to Canon Douglas.

Prof. D. T. Harris, since 1921 assistant professor in the Institute of Physiology at University College, has been appointed professor of physiology (London Hospital Medical College) as from Oct. 1.

The title of University reader has been conferred on Dr. Evelyn E. Hewer, lecturer in histology at the London (R.F.H.) School of Medicine for Women.

OXFORD.—Among the honorary degrees conferred on June 22 were the following: D.Sc. on Sir John Russell, director of the Rothamsted Experimental Station, and Prof. Willem de Sitter, professor of astronomy in the University of Leyden; D.C.L. on Sir Arthur Salter, recently director of the Economic and Finance Section of the League of Nations.

Sir James Frazer is to deliver the Sir Basil Zaharoff lecture for this year.

THE National University of Ireland is about to enter upon its twenty-fifth year and has signalised the approach of this anniversary and "the special signific-

ance of this year, 1932, in the religious and national as well as international life of the Irish people" by issuing a sumptuous "National University Handbook, 1908–1932". This volume, produced at the Sign of the Three Candles in Fleet Street, Dublin, by Colm O'Lochlainn, a graduate of University College, Dublin, deals with the whole of the academic activities of the University, its three constituent colleges at Dublin, Cork, and Galway, and the recognised national ecclesiastical college of St. Patrick, Maynooth, the relationship of the University to secondary schools, and its social and recreative interests. It includes lists of publications, literary and scientific, by the teaching staff and others holding higher degrees of the University. A chapter on applied science records achievements of four of its science graduates distinguished as research workers: Dr. E. J. Butler, director of the Imperial Bureau of Mycology at Kew since 1920; Dr. F. D. Murnaghan, who has held high appointments as a mathematician in the United States; Dr. T. A. McLaughlin, initiator and managing director during the constructive period of the Shannon Power Electrical Scheme; and Dr. J. J. Drumm, an account of whose remarkable traction battery by Prof. A. J. Allmand, published in NATURE of March 12, 1932, is reproduced in the Handbook. The development of work in applied science in the University has been fostered by the liberal system of travelling studentships, to which the Handbook refers as having provided awards far exceeding any similar facilities offered by other universities in the north-west of Europe.

THE University of London has published, in the form of a pamphlet entitled "New Buildings on the Bloomsbury Site" (18 pp. with illustrations and map), its first proposals for the development of this important site of ten acres behind the British Museum. As frontispiece is a photograph of the model prepared by the architect, Mr. Charles Holden, of the proposed University buildings as seen from Russell Square. The model, without detail or fenestration, gives an impression of a vast building, cunningly devised and working up to a great tower, placed centrally on the site and visible from the main approaches to the new buildings. The tower, as the architect explains, will dominate the group and will serve as the main entrance to the buildings—the administrative building to the south and the library and scholastic sections to the north. "The very orderly disposition of the parts", he adds, "and the strong horizontal character of the whole would give to the mass a classical bias which, together with the rhythmical disposition of the window and door openings and other essential features, may be relied upon to present a neighbourly front to the British Museum and to the surrounding buildings, without the necessity of introducing a columnar treatment." The nearest anatomical parallel to the plan is a spine with vertebræ extending from the tower to the northern extremity facing Gordon Square, the administrative block and the Great Hall forming the head and facing Sir John Burnet's northern extension of the British Museum with its classical columns, the Great Hall being on the Russell Square side of this frontage. The height of the tower is not stated, but it would appear to be about 200 ft.—in no sense a skyscraper, but high enough and impressive enough to give character and unity to the architect's design. The pamphlet includes an account of the history of the University, stressing appropriately its difficulties in finding suitable accommodation for its administrative work; and particulars are given of some of the purposes—university and collegiate—for which the new building will be devoted.

Calendar of Geographical Exploration

July 3, 1798.—The Zambezi and the Cunene

Lacerda left the Zambezi and travelled northwards between Lakes Nyasa and Bangweolo. He had previously explored the Cunene River, and thought that the upper course of the Zambezi might be connected with the Cunene. If this were so, he hoped that the Portuguese might establish cross-country trade between Mozambique and Benguela. Lacerda died in October 1798, and his party returned to Tete in November 1799. Much new information had been gained, but it was soon forgotten and was not available when Livingstone began his travels.

July 3, 1826.—The Arctic Coast of Canada, 1825–26

Sir John Franklin reached the head of the Mackenzie delta. There his party divided into two groups, Sir J. Richardson leading a group eastwards and Franklin going west. Richardson traced 863 miles of unexplored coast between the Mackenzie and the Coppermine Rivers, discovering and naming Franklin Bay, Wollaston Land, Dolphin and Union Strait, and Coronation Gulf. Franklin traced the coast westwards from the Mackenzie for 374 miles to Cape Beechey.

July 4, 1734.—The Siberian Arctic

Pavlov and Muraviev left Archangel to sail for the mouth of the Ob. The expedition formed one of the numerous surveys inaugurated by the Russian Senate, the Admiralty, and the Academy of Sciences in the thirties of the eighteenth century. The impetus towards the geographical survey of Siberia was given by Peter the Great, though the work was not begun until after his death. The boats of the 1734 expedition proved unsatisfactory and a second journey started in 1736, with Malygin in place of Muraviev. Malygin anchored in the sound now named after him; he and his companions mapped the coast of Yalmal and also of Byeli Ostrov. The Ob mouth and the Gulfs of Tas and Gyda were mapped as the result of Ovzyn's voyage (1734–37), while the coast between the Yenisei and the Taimyr Peninsula was explored by Minin in 1738–40.

July 8, 1497.—Vasco da Gama

Vasco da Gama with four vessels left the Tagus River on a journey which filled in the gap of 800 miles of unknown east African coast between the limit reached by Diaz in his 1487–88 voyage and the part known to the Arabs. After a five-thousand-mile ocean journey, he anchored off the west coast of South Africa near the Cape of Good Hope, where, in their eight days' stay, the Portuguese got into touch with the Hottentots. They put into Mossel Bay, and later passed the pillars set up by Diaz, thus entering unknown waters. Natal was passed on Christmas Day. At the Quilimane River they stayed for twenty-two days, suffering much from the low-lying, marshy nature of the coast. At Mozambique they met Arab dhows and learned from them the nature of their further journey along the east coast. The monsoon favoured them and they reached the Indian coast on May 23. The return journey from India to Africa occupied three months, and so many of the men became ill and died that one ship was abandoned in Mombasa; but after that the conditions were favourable and the first ship reached Lisbon in June 1499. Thus was inaugurated the sea route to India, which so profoundly affected the relations between Europe and Asia. Da Gama made a second voyage to India in 1502, and in 1524 was appointed Viceroy of Portuguese India, but died at Cochin on Dec. 24, 1524.

July 9, 1739.—Cape Chelyushkin

A Russian expedition under Lieut. Laptev left the mouth of the Lena, and reached Cape Thaddeus, 76° 47′ N., on Sept. 2. After wintering at the head of Khatanga Bay, Laptev tried to return to the Lena, but his vessel was nipped in the drift ice off the Olonek River. He and his men with infinite difficulty reached their former winter quarters. Thence Laptev and his second in command, Chelyushkin, made sledge journeys to survey the peninsula, and, in 1742, Chelyushkin reached by land the northerly cape which now bears his name.

Societies and Academies

LONDON

Royal Society, June 23.—**R. Whiddington and J. E. Taylor**: The photographic action of slow electrons. The photographic action of electrons (60-300 volts) has been experimentally investigated in the case of 'Imperial Duoplex' films. The formula connecting the blackening with the electron current producing it is of the same form as that known to hold in the case of light but with the constants appropriately changed. The 'inertia' of the film is considerably reduced by oiling its surface before exposure, almost certainly due to fluorescence of the oil under electron impact.—**A. Egerton and G. S. Callendar**: The saturation pressures of steam (170° to 374° C.). The saturation pressures of steam up to the critical point have been measured by a dynamic method using the apparatus designed by the late Prof. H. L. Callendar for the determination of the total heat of steam. The probable accuracy of the results is 1 in 6000. Previous results by statical methods had agreed satisfactorily to 270° C., but departed considerably from each other above that temperature. The present results lie in the region between the former determinations, and should help in the establishment of a precise knowledge of the thermal properties of steam.

DUBLIN

Royal Dublin Society, March 22.—**Henry H. Dixon and T. A. Bennet-Clark**: Electrical properties of oil-water emulsions with special reference to the structure of the plasma membrane (2). Previous work has been confirmed and extended by the use of modified methods and apparatus. It has now been shown that the electrical behaviour of water-in-oil emulsions agrees with that of cells in the several particulars. The sensitivity of a water-in-oil emulsion is raised with the increase of the sodium/calcium ratio. The change of resistance is associated with the elongation in the path of the current of the minute droplets of the water-phase of the emulsion, and inversion is not necessary even for large changes of resistance. The application of the emulsion-theory of the plasma membrane to the results of permeability experiments is discussed.—**Paul A. Murphy and Robert M'Kay**: A comparison of some European and American virus diseases of the potato. In a comparison of a number of European and American virus diseases of the potato undertaken some years ago, it was found that the latent viruses present in American 'healthy' potatoes, as well as in those showing symptoms of various diseases, seriously interfered with the results. The following diseases have been found to correspond on the two continents: leaf-roll, aucuba mosaic, interveinal mosaic, and witch's broom. American leaf-rolling mosaic may have affinities with paracrinkle. No equivalents have been found for six other virus diseases of the potato described in America.

PARIS

Academy of Sciences, May 17 (vol. 194, pp. 1697-1768).—**H. Vincent and L. Velluz**: The cryptotoxic properties of sodium α-oxynaphthoate. Its special action on the diphtheric toxin. Sodium α-oxynaphthoate possesses a selective neutralising action on the diphtheric toxin. The toxin thus neutralised ('cryptotoxin') injected into guinea-pigs gives neither local scar, paralysis, nor general troubles, and gives immunity against the diphtheria toxin.—**André Blondel**: The effect of hysteresis in heating by an oscillating magnetic field.—**Charles Nicolle, J. Laigret, Marcandier, and R. Pirot**: The rat, an animal reacting to benign endemic forms of typhus. The long conservation of virus in the rat. It has been found that the rat can act as a reservoir of the virus of some forms of typhus: for typhus of the Old World type, as distinguished from a second type (Toulons, Athens, and elsewhere), the rat carrying the virus shows no sign of infection.—**Charles Nicolle and L. Balozet**: An attempt to restore the original activity to rabic virus fixed by intracerebral passages on the dog. The experiments have led to an unexpected result. Instead of increasing the pathogenic power, the inoculations have specialised the virulence for the dog's brain and removed from the virus the power of causing hydrophobia except when placed in the brain.—**E. Mathias, W. J. Bijleveld, and Ph. P. Grigg**: The rectilinear diameter of the carbon monoxide molecule. Measurements of the densities of the liquid carbon monoxide and of its saturated vapour at the same temperature for absolute temperatures ranging between 68° and 131°.—**L. Léger and T. Bory**: *Eimeria pigra*, a new juxta-epithelial coccidium, parasitic on *Scardinius erythrophtalmus*.—Henry Perrier de la Bathie was elected *correspondant* for the Section of Botany.—**J. Favard**: The distribution of the points where a nearly periodic function takes a given value.—**de Séguier**: Normalisers of substitutions of order 2 of linear, quadratic, Hermitian, and skew groups in a Galois field of odd order.—**Mlle. Mary L. Cartwright**: Certain integral functions of finite order.—**Basile Demtchenko**: The variation of resistance at low velocities under the influence of the compressibility.—**J. Bion and P. David**: Daytime weakening of mean and intermediate (wireless) waves propagated over the sea. Sommerfeld's formula $d/\sigma\lambda^2$ (d, distance; σ, conductivity of the ground; λ, wave-length) has been hitherto examined by varying λ and d, since the conductivity of the sea is known (10^{-11}). For observations made over the sea, with wave-lengths, 700, 215, and 158 metres, and up to a distance of 1050 km., Sommerfeld's formula was found inapplicable: the empirical formula of Austin, on the contrary, gave figures very close to the experiments.—**J. Sambussy**: The part played by the nature of the electrodes in the conductivity of semiconducting liquids. The current flowing through a column of nitrobenzene depends partly on the material of the electrodes. Some peculiarities in the fall of potential per centimetre were observed with lead, and especially with tantalum electrodes.—**André Lallemand**: The variable paramagnetism of crystallised ferric chloride and the constant paramagnetism of the Fe_2Cl_6 molecule in the gaseous state. Constitution of the molecule Fe_2Cl_6. In the state of vapour, the two atoms of iron have equal magnetic moments, and hence possess the same valency.—**J. P. Mathieu**: Double salts, complex salts, and circular dichroism.—**René Lucas and Marcel Schwob**: The stroboscopic method for the measurement of electrical double refraction.—**Mlle. Ellen Gleditsch and Sverre Klemetsen**: The actinum-uranium ratio in an old uraninite-clevite from Aust-Agder (Norway). In this mineral the actinium found was 3·2 per cent of the

uranium. This agrees with the 2·7 per cent previously found for a Norwegian brœggerite and 3·3 per cent for a Cornish pitchblende.—**G. Reboul**: Radioactive phenomena of the second order and of artificial origin. —**Eugène Cornec** and **Henri Muller**: The lowering of eutectic points.—**M. Bourguel**: The influence of substitutions on the vibration frequency of ethylene compounds. A method of classification of radicals.—**R. de Fleury** and **Benmakrouha**: The utilisation of magnesium alloys.—**A. Sanfourche** and **A. Portevin**: A particular mode of corrosion of austenitic chrome-nickel steels. This steel, which resists completely the action of cold phosphoric acid, is rapidly corroded if this acid contains hydrochloric acid, even in small proportion. The effects of various treatments of the surface on this corrosion has been studied.—**Adrien Karl**: Synthetic willemite. The phosphorescence of natural willemite is usually attributed to the presence of impurities (Ni, Fe, Cu). Synthetic willemite, prepared from highly purified materials, showed a violet phosphorescence: the brilliancy of the phosphorescence was increased by the addition of nickel (1 to 2 per thousand) and copper (0·5 to 2 per thousand).—**P. Süe**: The dehydration of niobic acid.—**Maurice Loury**: Researches on the diaryl-arylethinyl carbinols. Phenyl-*p*-tolylphenylethinyl carbinol, $C_{22}H_{18}O$, and phenyl-*p*-bromophenylethinyl carbinol, $C_{21}H_{15}.O.Br$.—**Georges Lévy**: The preparation of a new ethylnaphthol.—**F. Loewinson-Lessing**: The hortonolite gabbro-diabases of the Siberian trappean formation.—**E. Chaput**: Geological observations in Asia Minor. The Trias of the Angora region.—**Mlle. Elisabeth David**: The presence of Lepidocyclines in the Eocene and their relations with the Lepidobitoides.—**Jules Amar**: The law of renal secretion.—**Philippe Fabre** and **Pierre F. Quesnoy**: The comparative efficacity of cuneiform waves of the second kind and of condenser discharges, with equal initial intensity.—**Michel Taguet**: A new method of studying microbial increase. The method is based on the measurement of the opacity of the culture, by the aid of a photo-electric cell. It is shown that the time-opacity curves for a given organism (*B. coli* in the example given) are superposable. Different organisms give different curves.—**Paul Durand**: Attempts at curative serotherapy of exanthematic typhus. A suitable quantity of the cephalo-rachidian fluid is removed and replaced by the serum. Temperature charts of twelve cases are given, showing the improvement effected.

ROME

Royal National Academy of the Lincei, Jan. 17.—**E. Paternò**: (1) Action of oxygen on sodio-cellulose. The action of oxygen on sodio-cellulose at 100° C. yields only β-cellulose (oxycellulose). At the same time the proportion of carbonate present increases appreciably, the carbon dioxide being formed, together with pentosans, from the cellulose according to the equation, $C_6H_{10}O_5 + O_2 = C_5H_8O_4 + CO_2 + H_2O$.—(2) Maturation of sodio-cellulose. This maturation is undoubtedly an oxidation process, the β-cellulose (oxycellulose) formed being transported through the xanthate to the artificial silk, of which it constitutes a normal component.—(3) So-called regenerated cellulose. In the various transformations it undergoes, cellulose can be regarded as regenerated only when the substances it has absorbed are eliminated by washing with water. If the cellulose has been converted into any compound or has passed into solution or been colloidally dispersed, it cannot be regenerated. For example, when cellulose is separated from its zinc chloride or ammoniacal copper solution, from xanthate or viscose, or from sulphuric, hydrochloric, or phosphoric acid solutions, it does not retain its initial properties. Cryoscopic determinations of the molecular weights of colloidal derivatives of cellulose are inconclusive.—**E. Bompiani**: The contact of two surfaces.—**U. Broggi**: The development of $\sum_{n=0}^{\infty}\left[b_n\left(\sum_{h=0}^{\infty} a_h x^h\right)^n\right]$ in series of increasing powers of x. —**G. Sansone**: The zeros of the polynomial solutions of the equation $(a_1x + a_0)y'' + (b_1x + b_0)y' - nb_1y = 0$ (1). —**F. Conforto**: Considerations on the impulses in isotropic elastic bodies.—**N. Moisseiev**: The law of the resistance to motion of bodies in a pulverulent medium. —**G. Petrucci**: Trains of waves emitted at constant time intervals.—**G. Todesco**: Experimental confirmation of the selective absorption of the Hertzian waves caused by an electronic gas in a magnetic field.—**A. Signorini**: Certain properties of the medium in ordinary elasto-statics.—**L. Infeld**: Remarks on the problem of the unitary theory of fields.—**Dina Lombardi**: Observations on the structure of the nucleus of the larva of *Cricotopus sylvestris* F.

SYDNEY

Linnean Society of New South Wales, March 30.—**G. H. Cunningham**: The Gasteromycetes of Australasia (14). The family Tulostomataceæ. This family is rearranged to contain the genera *Podaxon*, *Phellorina*, *Chlamydopus*, *Tulostoma*, *Queletia*, and *Battarræa*, all of which, save *Queletia*, have representatives in this biologic region, and is divided into subfamilies and tribes. The only representatives of the family found in New Zealand are confined to the genus *Tulostoma*.—**C. P. Alexander**: A review of the Tipulidæ of Australia (Diptera) (1). The historical development of the subject and the general facies and distribution of the Australian fauna are discussed. Keys are given for the subfamilies of the Tipulidæ and for the genera of the Tipulinæ, and the Australian species of *Clytocosmus* are reviewed.—**F. C. Chisholm**: The occurrence of *Atrax venenatus* on the Comboyne plateau. Both male and female examples of *Atrax venenatus* are recorded.—**Rev. H. M. R. Rupp**: Notes on New South Wales orchids (2). A new genus and species of subterranean orchids, allied to the Western Australian genus *Rhizanthella*, is described from Bullahdelah, and notes are given on other species belonging to *Diuris*, *Pterostylis*, *Dendrobium*, *Prasophyllum*, and *Cymbidium*.

VIENNA

Academy of Sciences, March 10.—**Karl Fritsch**: Observations on flower-visiting insects in Styria (1912). These observations, made in March–June and September–October in the neighbourhood of Graz and in other parts of Styria, extended to more than sixty plant species, including cultivated exotic species. It is noteworthy that the honey-bee was found to visit an ornithophilous plant, *Agave americana* L.—**Karl Przibram**: Radio-luminescence and radio-photoluminescence (3). Examination of the red fluorescence exhibited by many English fluorites after irradiation by radium reveals a band in the red without recognisable lines, this being often confined to certain positions on the crystal. Investigations with synthetic material show that red radio-photoluminescence occurs also with calcium fluoride free from rare earths. With fluorite this phenomenon is, therefore, attributed either to more frequent contamination with heavy metals and only modified by the simultaneous presence of rare earths or to the effect of the rare earths themselves, which do not then emit their characteristic lines.—**A. Dadieu**, **K. W. F. Kohlrausch**, and **A. Pongratz**: Studies on the Raman effect (19). The Raman spectrum of organic substances (isomeric paraffin derivatives). For the vibration spectrum the substituents CH_3, NH_2, and OH are mechanically

almost equivalent, so that paraffin derivatives containing only these substituents yield vibration spectra of a different type (corresponding with higher molecular symmetry) from those of analogous derivatives with the substituents SH, Cl, Br, etc.—Friedrich Lechner: Studies on the Raman effect (20). Theory of the valency force system with three mass points.

Forthcoming Events

MONDAY, July 4

Royal Institution (General Meeting at the Institution, 21 Albemarle Street, London, W.1), at 5 p.m.

FRIDAY, July 8

Physical Society of London (Special General Meeting at the Imperial College of Science and Technology, South Kensington, S.W.7), at 5 p.m.

SATURDAY, July 9

Society of Chemical Industry—South Wales Section (Special Joint Meeting with the South Wales Section of the Institute of Chemistry at the laboratories of the Cardiff Gas, Light and Coke Company, Bute Terrace, Cardiff), at 3 p.m.

Official Publications Received

British

The Quarterly Journal of the Geological Society of London. Vol. 88, Part 2, No. 350. Pp. 111-311. (London: Longmans, Green and Co., Ltd.) 7*s*. 6*d*.

Report of the Haffkine Institute for the Year 1930. By Major L. A. P. Anderson. Pp. 76. (Bombay: Government Printing and Stationery Office.) 6 annas; 8*d*.

Journal of the Chemical Society. May. Pp. v+1338-1641+x. (London: Chemical Society.)

Armstrong College, Newcastle-upon-Tyne: Standing Committee for Research. Report, Session 1930–1931. Pp. 86. (Newcastle-upon-Tyne.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 20, N.S., Nos. 18-20: On Alginic Acid, its Mode of Occurrence and its Constitution, by Dr. Thomas Dillon and Annie McGuinness; The Performance of a Reservoir subjected to Flood, by H. H. Jeffcott; Cytological Studies of Potato Plants affected with certain Virus Diseases, by Dr. Phyllis Clinch; The Effect of an Insufficient Supply of Vitamin D on the Growth of the Skeleton and Internal Organs of Chickens, by E. J. Sheehy and Miss K. Sheil; Report on the Recent Bog-Flow at Glencullin, Co. Mayo, by A. D. Delap, A. Farrington, R. Lloyd Praeger and Louis B. Smyth; A Critical Review of some Recent Work on the Occurrence of Virus Complexes in the Potato, by Dr. Paul A. Murphy; Electrical Properties of Oil-Water Emulsions, with Special Reference to the Structure of the Plasmatic Membrane, II, by Prof. Herbert H. Dixon and Dr. T. A. Bennet-Clark; The Compound Nature of Crinkle, and its Production by means of a Mixture of Viruses, by Dr. Paul A. Murphy and Robert M'Kay. Pp. 129-247+plates 4-12. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 12*s*.

Imperial Bureau of Plant Genetics: Herbage Plants. Bulletin No. 7: Further Contributions on the Technique employed in the Breeding of Herbage and Forage Plants. Pp. 33+4 plates. (Aberystwyth: Agricultural Buildings.) 2*s*.

The Film in National Life: being the Report of an Enquiry conducted by the Commission on Educational and Cultural Films into the Service which the Cinematograph may render to Education and Social Progress. Pp. xii+204. (London: George Allen and Unwin, Ltd.)

Memoirs of the Royal Meteorological Society. Title-Page, Contents, Summaries and Discussion, Vol. 2, Memoirs Nos. 11-20, 1927–1928. Pp. iv+173-185. (London: Edward Stanford, Ltd.) 2*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1449 (S. 100): Anchors for use on Flying Boats. By L. P. Coombes and the Experimental Staff of the Marine Aircraft Experimental Establishment, Felixstowe. Pp. 14+10 plates. 1*s*. 3*d*. net. No. 1421 (T. 3053, 3178): Spinning of a Single Seater Fighter with Deepened Body and Raised Tailplane. Part 1: Model Experiments, by H. B. Irving and A. S. Batson; Part 2: Full Scale Spinning Tests, by A. V. Stephens. Pp. 16+20 plates. 1*s*. 3*d*. net. No. 1443 (T. 3164 and "a"): Wind Tunnel Tests on Aileron Loads. By F. B. Bradfield, G. F. Midwood and F. R. C. Hounsfield. Pp. 20+25 plates. 1*s*. 3*d*. net. (London: H.M. Stationery Office.)

Memoirs and Proceedings of the Manchester Literary and Philosophical Society. Vol. 75, 1930–31. Pp. iv+117+lxix. (Manchester.) 10*s*.

Proceedings of the Royal Society. Series A, Vol. 136, No. A830, June 1. Pp. 465-766. (London: Harrison and Sons, Ltd.) 12*s*. 6*d*.

Transactions of the Optical Society. Vol. 33, 1931–32. No. 2. Pp. ii+37-72. (London: Optical Society.) 12*s*.

Royal Observatory, Hong Kong. The Climate of Hong Kong, 1884–1929. By T. F. Claxton. (Appendix to Hong Kong Observations, 1931.) Pp. 38+31 plates. (Hong Kong.)

Commonwealth of Australia. Fifth Annual Report of the Council for Scientific and Industrial Research for the Year ended 30th June 1931. Pp. 54. (Canberra: H. J. Green.)

The Economic Botany of Cacao: a Critical Survey of the Literature to the end of 1930. By Prof. E. E. Cheesman. Pp. 16. (Trinidad: Government Printing Office.) 1*s*.

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1932 June 4. Pp. 19. (Greenwich.)

Commonwealth Bureau of Census and Statistics, Canberra. Official Year Book of the Commonwealth of Australia. No. 24, 1931. Compiled by Chas. H. Wickens. Pp. xxxii+808. (Canberra: H. J. Green.) 5*s*.

Proceedings of the Royal Irish Academy. Vol. 40, Section B, No. 15: The Fens of North Armagh. By J. M. White. Pp. 233-283+plate 6. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2*s*. 6*d*.

Foreign

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 84. West Mexican and Central American Mollusks collected by H. N. Lowe, 1929–31. By H. A. Pilsbry and H. N. Lowe. Pp. 33-144+17 plates. A Collection of Birds from Southwestern Africa. By Rodolphe Meyer de Schauensee. Pp. 145-202+plates 18-26. The Name of *Lophoceros bradfieldi* from Bechuanaland and Rhodesia. By Rodolphe Meyer de Schauensee. P. 203. (Philadelphia.)

Smithsonian Miscellaneous Collections. Vol. 87, No. 8: Graphic Correlation of Radiation and Biological Data. By F. S. Brackett. (Roebling Fund.) (Publication 3170.) Pp. 8. (Washington, D.C.: Smithsonian Institution.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 83, 1931. Pp. iii+487+41 plates. (Philadelphia.) 6.25 dollars.

Conseil Permanent International pour l'Exploration de la Mer. Faune ichthyologique de l'Atlantique nord. Publiée sous la direction de Prof. Joubin. No. 9. 24 planches. 4.00 kr. No. 10. 24 planches. 4.00 kr. (Copenhague: Andr. Fred. Høst et fils.)

Proceedings of the Imperial Academy. Vol. 8, No. 4, April. Pp. vii-viii+113-141. (Tokyo.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 11, 1929. iii. Vattenstånden vid Rikets kuster. Pp. 21. 2.00 kr. Årsbok, 11, 1929. iv. Meteorologiska iakttagelser i Sverige, Band 71. Pp. x+179. 7.00 kr. Årsbok, 12, 1930. v. Hydrografiska mätningar i Sverige. Pp. 40. 3.00 kr. Årsbok, 13, 1931. i. Månadsöversikt över väderlek och vattentillgång jämte anstaltens årsberättelse. Pp. 94. 2.50 kr. (Stockholm.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 4, No. 5, Mai. Pp. 193-288. (Prague: Regia Societas Scientiarum Bohemica.)

Ministry of Public Works, Egypt: Physical Department. Meteorological Report for the Year 1926. Pp. xi+156. (Cairo: Government Press.) 40 P.T.

League of Nations' Intellectual Co-operation Organisation. Information Bulletin, Vol. 1, No. 1, April. Pp. 32. (Paris.) 1*s*.

Smithsonian Miscellaneous Collections. Vol. 87, No. 9: Periodicity in Solar Variation. (Roebling Fund.) By C. G. Abbot and Gladys T. Bond. (Publication 3172.) Pp. ii+14+2 plates. (Washington, D.C.: Smithsonian Institution.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 33, Part 1: Studies on the Morphology and Ecology of the Rice Leaf-Beetle, *Lema oryzae* Kuwayama, with Special Reference to the Taxonomic Aspects. By Satoru Kuwayama. Pp. 132+4 plates. (Tokyo: Maruzen Co., Ltd).

Publications of the Allegheny Observatory of the University of Pittsburgh. Vol. 9. Pp. iii+218. (Pittsburgh, Pa.)

Science Reports of the Tokyo Bunrika Daigaku, Section B. No. 1: Über die Farbbarkeit der fixierten Zellstrukturen. Von Gihei Yamaha. Pp. 21. 25 sen. No. 2: Zur Kenntnis der Alginsaure, I. Von Tomo-o Miwa. Pp. 23-37. 23 sen. No. 3: On the Sexual Reproduction of *Prasiola japonica* Yataba. By Yoshitada Yabe. Pp. 39-40+1 plate. 10 sen. (Tokyo: Maruzen Co., Ltd.)

National Research Council of Japan. Report No. 8-9, April 1928–March 1930. Pp. iii+229-350. (Tokyo.)

Proceedings of the Delaware County Institute of Science. Vol. 9, No. 4. Pp. 158-204. (Media, Pa.)

Peking Natural History Bulletin. Vol. 6, Part 4: Chinese Materia Medica. vi: Avian Drugs. By Bernard E. Read. Pp. 112. (Peiping: The French Book Store.) 1.50 dollars.

The Science Reports of the National Tsing Hua University. Vol. 1, No. 4, May. Pp. 129-157. (Peiping.)

Egyptian Government: Ministry of Public Works. Annual Report for the Year 1927–1928. Part 1. Pp. vi+166. (Cairo: Government Press.) 20 P.T.

Publications of the Manila Observatory. Vol. 3, Nos. 1-10: Oceanographic Papers. Report of the Subcommittee on Physical and Chemical Oceanography of the Philippine Islands to the International Committee on Oceanography of the Pacific Science Congress. By Rev. Miguel Selga, Rev. Wm. C. Repetti, Wallace Adams. Pp. 210. (Manila: Bureau of Printing.)

Report of the National Research Council for the Year July 1, 1930–June 30, 1931. Pp. iv+92. (Washington, D.C.: Government Printing Office.)

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SATURDAY, JULY 9, 1932

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Professional Codes and Business Practice

ONE of the most interesting features in the recently published report of the Medical Research Council for 1930–31 is the evidence it affords of growing relations between the medical profession and manufacturing firms. The disinclination of such professions as law and medicine to have connexion with trade is an inherited prejudice which, however natural or healthy in its origin, in modern society can be greatly to the public disadvantage. As the report points out, the greater reluctance of medical men in Great Britain as compared with their continental colleagues to undertake clinical trials of new synthetic substances of therapeutic importance in co-operation with manufacturers, and to publish the results over their own names, frequently militates against the clinical application of scientific research carried out at the universities. New substances first produced in Great Britain sometimes come into general recognition and use by way of clinical reports published in German and other foreign journals.

The problem of securing trustworthy clinical trials of new substances produced by manufacturing firms has recently been discussed by the Medical Research Council with representatives of the Association of British Chemical Manufacturers, and a Therapeutic Trials Committee has been organised under the supervision and authority of which trials of new products may be arranged. This Committee is in close touch with the Chemotherapy Committee, which may be responsible for the experimental work desirable or necessary before the drugs or preparations are used in man, and, in consultation with the Association of British Chemical Manufacturers, agreed conditions have been accepted under which the new substances may be submitted to the Therapeutic Trials Committee for clinical study.

These developments, while affording a welcome indication of the breakdown of earlier prejudices against participation in industry, are only a new phase of relations between the Medical Research Council and chemical industry which have existed for some time. The function of the Council to assist in rendering the results of scientific discovery available for the public and the medical profession frequently involves establishing close co-operation between the original scientific workers and those whose work is concerned with the developments necessary for manufacture and application of the discovery. Only by such co-operation is it often possible to minimise the delay in the elaboration of the necessary technique for economic and successful

production on a large scale. It is thus inevitable that some relations with chemical industry should exist, and the closer the co-operation the easier it is to negotiate the difficult path between the laboratory discovery and successful manufacture, and the more rapidly will the manufactured product become available for general clinical use.

This problem of development is, however, by no means peculiar to pharmaceutical preparations. It is encountered in many other fields of industry, where new and improved products are continuously being developed as a result of research. The adage that the good is enemy of the best finds perennial expression in, for example, engineering, where the manufacturer of a new and greatly improved alloy is often faced with the problem of convincing a prospective user that it is worth while paying ten per cent more for an article which is really a hundred per cent better than the original. It is undeniable that the successful application of research is largely dependent upon the user's appreciation of the value of the products which it puts at his disposal. Unless the user—who is not necessarily the ultimate public, but may be a professional man, such as a physician, or a manufacturing firm purchasing, for example, alloys for constructional purposes—is ready to adopt new products, the manufacturer finds little encouragement for his expenditure on the development of new and improved articles. The difficulty is increased because, under the present conditions of trade and industry, the mechanism of buying and selling departments is largely in the hands of those who are not trained technicians, and are unable to assess independently the merits of the new products, or to distinguish exaggerated or unreliable claims made in advertising literature.

Serious efforts are, of course, being made to overcome this difficulty in fields other than that of medicine. The Institute of Metals, for example, has endeavoured to bring into personal contact the technical as well as the business men concerned with the manufacture of materials and their application in engineering and elsewhere. Much of the propaganda literature now issued by industrial firms is highly informative and frequently contains scientific data not published elsewhere and of real value to users of the products described. Such publications are now being treated much more seriously, and deserve no longer to be confined to the offices of the buying department, but to be indexed and circulated to the technical staff in the same way as the recognised scientific journals in which much of the information may be afterwards published.

In spite of these efforts, absence of technical knowledge in the buying department may often lead to a mistaken insistence on a cheaper material when the new and possibly more expensive product would really prove far more satisfactory or economical, and at the best the wheels of progress are clogged and efforts to improve products are hampered.

Thus the experience of such diverse industries as the metal and engineering industries and the fine chemical industry indicates that much more is being demanded of scientific workers in every aspect of industry, and that progress demands the rapid disintegration of those prejudices which formerly kept professional men and industry apart. The scientific outlook and a scientific or technical training are becoming as important, if not as indispensable, in the buying and selling organisations of industry as in the control of technical operations or in research. Equally it appears that the scientific worker might make an important contribution even in the publicity or advertising side of industrial organisations, at which in the past he has been prone to look askance. It is only as he contributes both his scientific knowledge and his professional integrity and traditions to the development of advertising literature of real scientific merit that some of the obstacles to the development of new products can be most easily overcome. The development of such methods in advertising is a logical outcome of the rationalisation of industry, but its achievement requires the co-operation of scientific workers as professional men. The report of the Medical Research Council already makes it plain that such professional co-operation is imperative in the public interest if new remedies are to be tested and developed adequately, and a change in the attitude of the medical profession to advertising seems inevitable.

Fundamentally these changes or tendencies are but an indication of the impossibility of dealing with industry or society in watertight compartments, or of restricting the influence of scientific thought once scientific methods have been applied to any extent. Inevitably a scientific outlook is required in every sphere of life, and while this will only be attained when science finds its rightful place in our educational system, much depends on the contribution of the scientific worker himself. It is only as he is brought into closer and more open contact with the general public that society can understand the true meaning of scientific methods and their contribution to the common weal.

The task which thus devolves on scientific

workers is by no means simple. While safeguarding their professional codes and standards of qualification, they are called upon to participate in the general life of the community, divesting themselves of that air of mystery which hinders the proper appreciation of their work and is often regarded as a cloak for humbug and inefficiency. We cannot expect that science and its methods will exercise the influence that is so essential to-day, in all aspects of social and economic life, unless in their own professional conduct and organisations scientific men are dominated by scientific and rational principles. Habits tending to secrecy, with the encouragement which they inevitably give to quackery, must definitely be discarded; and the indications that the medical profession is more disposed to co-operate with other classes of scientific workers and to abandon older prejudices are the more welcome because conservatism and the species of mental inbreeding which it engenders are among the greatest dangers to the efficiency of professional workers, whether in science or in other fields of human endeavour.

Vitamins

The Vitamins. By Dr. Ethel Browning. (Monographs of the Pickett-Thomson Research Laboratory, Vol. 1.) Published for the Pickett-Thomson Research Laboratory. Pp. xxxii + 575 + 7 plates. (London: Baillière, Tindall and Cox; Baltimore, Md.: The Williams and Wilkins Co., 1931.) 42*s.* net.

CONFRONTED with a volume such as that recently written by Dr. Ethel Browning, a reader becomes acutely aware of the interest which the discovery of vitamins has aroused throughout the scientific world and the enormous amount of work this has elicited in the brief period of one decade. It is probably true to say that no other fundamental discovery in biological science has led to such concentrated research in so short a time.

Various kinds of books on the subject of vitamins can be imagined, but two types suggest themselves at once: one to tell the general public the entrancing story of their discovery, history, and practical importance in health; the second to set out for the teacher and laboratory worker the detailed facts of their action and to guide him in tracking down the original source of knowledge on individual points. The writer of either of these books should be possessed of the wisdom of Solomon, but in the second case he must also have a more extensive knowledge, not only of physiology, pathology, and medicine, but also of physics and chemistry, as well as a personal experience of laboratory and clinical feeding tests.

Popular books on vitamins have been published from time to time, but the majority of the writers leave the average reader with a feeling that vitamins are substances of great importance only for polar explorers and those whose diet consists of polished rice. The fact is, of course, that the discovery of these substances and their actions is leading to one of the greatest silent revolutions Great Britain has ever experienced, a revolution in health and physical welfare, which will compare in magnitude with that following the discovery of the part played by micro-organisms in disease. It is becoming more generally recognised that in some respects the nutritional condition of our population is appalling, and that an infinite amount of physical defect, pain, and ill-health results from improper feeding, especially in early life. Knowledge of the nutritional factors responsible for such widespread defects as rickets, decayed teeth and pyorrhœa, and their sequelæ is being firmly established. Instead of an ill-grown, bandy-legged, anæmic population with septic and edentulous mouths, we already know how to substitute a taller, heavier, straight-limbed race with well-grown jaws and strong, healthy teeth. A popular book on vitamins should tell the world these facts and how they can be procured. Ultimately even the politician might be moved to do something in the matter and direct his attention to the prevention rather than the cure of disease.

The second type of book, namely, that dealing in a comprehensive way with all the scientific facts at present known about vitamins, had obviously to be written if progress was not to be impeded by needless repetition, by saturation of the research mind with a mass of unco-ordinated facts, and by endless waste of individual time in exploring the literature. So early as 1919 the Medical Research Council prepared a monograph of this kind; a second edition appeared in 1924, while the third is now in the press. This book has been written by a group of experts and practical workers, for it was thought only in this way could a satisfactory standard be reached. Now we find Dr. Ethel Browning tackling the job single-handed. The least the present reviewer can do is to bow his head and express his admiration of her pluck and energy in making such an attempt. This emotion is not lessened when he sees that the book is of quarto size, contains 432 pages of text, 90 pages of references to literature, about 50 pages of index of authors and subjects, and 7 excellent plates showing

histological changes associated with vitamin deficiency or excess.

In the introduction, the author states that attention has been primarily focused during the last few years on the attempt to isolate vitamins as chemical entities. She has therefore tried to neutralise this tendency to develop the subject into a biochemical treatise by devoting as much attention as possible to the clinical and experimental aspects, for she says that "it is, after all, in the preventive and therapeutic possibilities of vitamin administration that their ultimate importance to humanity in general will consist". This object is undoubtedly to be commended, especially as much of the chemical work has been unproductive.

Part 1 of the book opens with a historical sketch of the discovery of vitamins, and this is followed by a survey of their physiological actions, together with a description of the methods for their quantitative estimation known at the time of writing. The second part discusses in detail the properties, functions, and distribution of the fat-soluble vitamins A, D, and E, while in the third part the water-soluble vitamins B and C are similarly treated. Excellent tables indicating the vitamin content of foodstuffs are given, with references to the various authors from whose publications the facts are taken.

The book is well set out and any particular aspect that the reader wishes to study can be easily traced by means of the index, and the references to the investigations mentioned can readily be found. The author not only gives references to the literature, but also she has obviously read many of the papers carefully (although in some instances she has quoted extracts from them without either knowledge or thought as to their accuracy). Further, she has attempted to give a critical historical account of the development of knowledge in many branches of the subject. This makes the book more interesting to the average reader, but it has obvious pitfalls, for those in the inner secrets of the vitamin story know only too well that the real history of many of these discoveries is familiar to few outside the actual workers themselves.

It is evident that the vastness of the subject has handicapped the writer, especially as she has aimed at the inclusion of all investigations, good, bad, and indifferent, and has mentioned each, irrespective of the weight of scientific evidence. Consequently, the value of the book to the reader with no specialised knowledge is seriously impaired, for sometimes evidence quoted in one sentence is negatived by that given in the next. Again, there are examples of quotations from work which, in the light of later advances in technique, has lost its significance, and therefore its value is negligible to all except the most specialised worker.

In many respects Dr. Browning's book is very good, and its merits are sufficient to outweigh most of the errors, but it is doubtful whether they are great enough to counterbalance the effect of the uncritical 'all-in' method of exposition adopted by the author.

The Nature of Physical Theory

The Nature of Physical Theory: a Study in Theory of Knowledge. By Prof. Victor F. Lenzen. Pp. xii + 301. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 21*s*. net.

"IT is the purpose of this book to analyse the concepts, principles and systems of physical theory." There are many books with that purpose appearing to-day; a feature common to most of them is a lack of reference to any of the others. In this respect Prof. Lenzen's book is no exception; some of the most prolific writers, such as Dingler, Jeffreys, and (perhaps I may add) Campbell, are not mentioned at all; most of the references to the others are merely incidental and give no idea of their main conclusions.

Several explanations suggest themselves. One, doubtless supported by those who still regard any attempt to go behind the imitative orthodoxy of our textbooks as scientifically immoral, is that all such inquiries are inevitably barren, and that no one does or can say anything on such subjects worth the attention of others. Another is that those who are concerned with principles are naturally impatient of conventions, and that writers in this group are reacting—perhaps reacting too far—from the exaggerated importance that is attached in technical writings to giving chapter and verse for every statement, however obvious, that anyone has ever made before. A third is that the subject is so vast that no writer can possibly cover the whole of it, that all treatments of it are necessarily eclectic, and that so far no writer has needed to refer to the work of any other, because he has always been dealing with an untouched part of the field. Prof. Lenzen would obviously reject the first explanation; he would probably admit that the second is partially true, and that many of his ideas, though not formally 'acknowledged', are not original; but the third he would regard, I think, as going to the root of the matter. Others writers, he would

say, though their works may be learned and profound, have not answered the particular questions in which he is interested.

If this is the reason why he has neglected previous work almost completely, it becomes very important to know precisely what are the questions he is trying to answer. After the sentence already quoted, he continues: "The procedure will be to build up physical theory from the aspects of the physical order given in sensation". That suggests that the relation between physical theory and the experiments on which it is based is to be his main theme. As a matter of fact, it is avoided so completely that the problems connected with the terms *induction*, *probability*, *experimental error* are not even mentioned; none of these terms, nor any equivalents for them, appear in the index. Other passages in the introduction suggest that Prof. Lenzen takes the typically philosophical view that physical theory consists of a set of definite propositions, the origin of which is not important, and that his problem is to exhibit them as a systematic whole, free from logical contradiction. But then it is surprising to find him so little concerned with the classical paradoxes, such as those of statistical mechanics; he does not seem to realise that there is any difficulty in the conception of *molekular ungeordnet*. Nor does he actually show himself indifferent to origins. If "the data of experimental physics consist of space-time coincidences", what relevance other than historical can the "sensation of hotness and coldness" have for the concept of temperature? And if history is Prof. Lenzen's concern, what are we to make of his statement that *space*, of which Archimedes knew nothing and Newton very little, is one of the fundamental concepts of physics?

An uncomfortable suspicion is thus generated that Prof. Lenzen has no definite aim, and that his sturdy independence arises from ignorance of what others have said. It is inevitably confirmed by his treatment of subjects, such as measurement, on which much has been said; for it is difficult to find any other reason why he should simply ignore distinctions on which others have insisted. I hope that I am wrong and that others will find a unity and a profundity in Prof. Lenzen's work which I have missed; but as it is, I am debarred from performing adequately even the first duty of a reviewer, namely, to describe clearly what the book is about. Let me end, therefore, by simply giving a list of the chapter headings, from which readers may judge for themselves: General Character of Physical Theory. I.—Special Classical Theories, (i) Fundamental Concepts and Methods, (ii) Euclidean Geometry, (iii) The Theory of Time, (iv) Kinematics, (v) Dynamics, (vi) Electrodynamics, (vii) Thermodynamics. II.—Unitary Systems of Physical Theory, (viii) The Mechanical, Electrodynamic and Geometrical Conceptions of Nature (viii, ix and x, xi and xii). III.—Quantum Theory, (xiii) The Classical Quantum Theory, (xiv) Symbolic Quantum Mechanics. IV.—Methodological Principles, (xv) The Concept of Substance, (xvi) The Concept of Causality.

NORMAN R. CAMPBELL.

Science and Poetry

(1) *The Captive Shrew: and other Poems of a Biologist.* By Julian S. Huxley. Pp. xii+101. (Oxford: Basil Blackwell, 1932.) 5*s.* net.

(2) *Lyra Modulata.* By Sir Ronald Ross. Pp. 21. (London: Harrison and Sons, Ltd., 1931.) 10*s.* 6*d.*

(3) *In Exile.* By Sir Ronald Ross. Third edition. Pp. xii + 80. (London: Harrison and Sons, Ltd., 1931.) 10*s.* 6*d.*

THE prediction of Wordsworth a hundred years ago seems to be coming true. There is more and more fine verse directly and avowedly inspired by science. We have noticed in these columns more than once the trilogy of Mr. Alfred Noyes on the growth of science, the "Torch Bearers" in their triple aspect towards the heavens, the earth, and suffering man. The works now before us by Sir Ronald Ross and Prof. Julian Huxley have the added and special interest of being poems by men of science themselves. They are alike in this and in being good: all of them are well worth printing and many of them deserve to live. But in other respects the two poets are in marked contrast.

(1) Julian Huxley's little book brims over with merry thoughts and delight and questioning about all the sights in Nature which he remembers from boyhood up. Mountains, trees, birds—especially birds—and all sorts of light-effects in sun and moon; the poems, short as they are, are full of such touches and it is tempting to quote. Then in the later ones come half-serious, half-laughing comments on the universe of Jeans and the self of Freud. It is a delightful book, the fruit of a lively receptive mind, with reminiscences of Walt Whitman in its *vers libres* and of Browning in its ingenious rhymes.

(2 and 3) Sir Ronald Ross is extraordinarily different in style and temper; yet, as another man of science, alike in the questioning spirit displayed so strongly in his life-work and in the thoughts on

man's place in the universe with which the volume ends. The volume called "In Exile" contains verses written during his work in India in the 'nineties on malaria. They are now reprinted in a third edition with a preface in which Sir Ronald comments on the strange neglect with which the earlier issues were received. He is fully justified in his consciousness of their unique interest, deeply moving utterances wrung from the soul of a man in grips with one of the most terrible scourges of the human race. He is longing all the time for the sympathy and refreshing vigour of his native land, and weighed down by the horrors of the pitiless climate and the poverty and suffering of those around him. He is steadily approaching by patient and unrelaxing efforts the solution of one of the great evils which oppress his fellows. The poems have therefore a permanent and intense significance. They are hammered out with the utmost care, and will undoubtedly retain their value both as poetry and as the record of one of the most decisive applications of science to the alleviation of human suffering.

One must regret that the format and the price at which both Sir Ronald's volumes are produced will still confine their appreciation to a small circle of readers. Sir Ronald, akin in this to the late Poet Laureate, is keenly interested in the technique of verse and offers several experiments in the smaller and later book. Of all the poems included, that called a 'Pæan', which concludes the earlier book, best expresses in restrained and pregnant words the spirit of man's upward march. It has something of Shelley's triumphant ode, but ends on a note of greater wistfulness and need of effort. F. S. M.

Sugar Cane Entomology

Handbook of the Insects and other Invertebrates of Hawaiian Sugar Cane Fields. Compiled by Francis X. Williams. Pp. 400. (Honolulu, Hawaii: Hawaiian Sugar Planters' Association, 1931.)

THIS volume is a handbook dealing with the creatures inhabiting the Hawaiian sugar plantations—it is, in fact, a guide to the invertebrate fauna of the fields. It treats not only of species that are definitely injurious in one way or another, but also of those that are beneficial either in the rôle of parasites or of predators. At the same time, species that are more or less neutral, in their relations with the cane crop, also come in for consideration. In a few words, it enables any creature found in the cane fields to be identified, its biological status to be ascertained, and also whether it is indigenous to the islands or accidentally, or intentionally, imported. Insects naturally occupy the major portion of the book, but there are also included sections dealing with Myriapoda, Arachnida, Isopoda, Mollusca, and Nematoda. Of these several minor sections, that concerned with nematodes is of special importance.

The members of the entomological staff of the Sugar Planters' Experiment Station at Honolulu have built up for themselves a high reputation. Some of the best-known names are those of Englishmen. Their achievements in the domain of biological methods of pest control are unique and are the envy of the rest of the world. It is not too much to say that their achievements resulted in the saving of the whole archipelago from utter ruin of the cane-growing industry.

The policy of the governing body of the Honolulu Station is one that might be emulated with advantage elsewhere. This policy has been based upon the fullest application of scientific principles to the cultivation and protection of the sugar cane. The governing body has selected its staff from among men of real scientific calibre and has given these men constant moral and financial support. We see the reward of a consistent scientific policy in the comparative freedom from serious insect pests enjoyed by the Hawaiian cane fields to-day. This result has not been achieved through the perpetual spraying and dusting of crops with toxic compounds—it has come about through the judicious introduction of the right kinds of parasites and predators from other lands, coupled with a vigilant quarantine system. Let us hope that the same sound principles that have guided the Station's policy in the past will be rigidly pursued without relaxation. Increased facility for communication with the rest of the world affords increased chances for noxious immigrants to be carried to the islands. To preclude their obtaining a foothold in so congenial a climate demands constant watchfulness. Happily, both the quarantine service and the specialists at the Planters' Experiment Station work harmoniously towards this same object.

In his introduction to this volume, the late Dr. F. Muir sets out the guiding principles that have led to the remarkable success of biological control in the Hawaiian Islands. Dr. Muir's practical experience in this domain is perhaps unequalled, and his remarks in consequence are authoritative. The rest of the book is written by Dr. F. Williams, well known for his researches on the aculeate

Hymenoptera and other groups. In carrying out this task he has brought together the work of many investigators over a diverse field. Much of the original information is based on researches the results of which have appeared in bulletins and other publications seldom found in libraries in Europe. It is therefore gratifying to find much of this work thus brought together in a convenient compass and shown in its true perspective, accompanied by the original high-class illustrations. At the end of the book there is a very complete bibliography and an adequate index. A. D. IMMS.

Short Reviews

Handbuch der Klimatologie. Herausgegeben von W. Köppen und R. Geiger. In 5 Bänden. Band 1, Teil A: *Mathematische Klimalehre und astronomische Theorie der Klimaschwankungen.* Von Prof. M. Milankovitch. Pp. iv + A176. 27 gold marks. Band 1, Teil D: *Mikroklima und Pflanzenklima.* Von Dr. Rudolf Geiger. Pp. iii + D46. 9 gold marks. Band 1, Teil E: *Einfluss des Klimas auf den Menschen.* i. *Medizinische Klimatologie,* von Dr. W. Borchardt; ii. *Klima und Kultur,* von Prof. Dr. K. Wegener und Prof. Dr. W. Köppen. Pp. iii + E80. 11·70 gold marks. Band 1, Teil F: *Klimatologie der freien Atmosphäre.* Von Prof. Dr. A. Wagner. Pp. iii + F70. 12·60 gold marks. Band 4, Teil R: *Klimakunde von Hinterindien und Insulinde.* Von Dr. C. Braak. Pp. iv + 125. 31·20 gold marks. (Berlin: Gebrüder Borntraeger, 1930–1931.)

SINCE the last (third) edition of Hann's "Climatology" appeared in 1908–11, the observed data have enormously increased for nearly all parts of the earth. The need for a critical comparative compilation of this mass of facts is evident, and Profs. Köppen and Geiger have therefore planned a large handbook of climatology, dealing with the whole subject, including many more meteorological elements than were tabulated by Hann. The complete work will be more than twice as large as Hann's last edition. Naturally it is to be a co-operative work, and although the main language used in it is German, several British and American authors, dealing with parts of the British Empire and North America, will write in English. It is hoped that the whole handbook will be published in 1934. It will occupy five volumes, each comprising several parts appearing separately; the quoted prices for these parts are for separate sales, there being a reduction of one-third if the whole handbook is ordered; even so, the prices seem high, particularly for the part last issued (vol. 4, part R, costing more than 20 gold marks, reduced price, for less than 130 pages, in paper covers). At present, four parts of volume 1, and one of volumes 2, 4, are issued.

An unfortunate feature of this piecemeal production is that most of the parts, which in some cases are of considerable length, have no alphabetical authors' or subject index; these are apparently reserved for the completion of the whole handbook, since the concluding part (F) of volume 1 (of which two parts are still missing) has no index. The first volume deals with general climatological questions, and the remaining four with regional climatology. Part A of volume 1 is largely devoted to a lengthy exposition by Prof. Milankovitch of the radiative equilibrium of the atmosphere, and of his astronomical theory of the ice ages (a much-disputed topic), and contains no mention of Simpson's important work on these subjects. S. C.

Some East African Coniferæ and Leguminosæ. By Dr. L. Chalk, Dr. J. Burtt Davy and H. E. Desch. (Forest Trees and Timbers of the British Empire, 1.) Pp. 68 + 10 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 5*s.* net.

THIS is the first of a series dealing with the forest trees and timbers of the British Empire, edited by Dr. L. Chalk and Dr. J. Burtt Davy, of the Imperial Forestry Institute, Oxford. The series will supply a want which has long been felt, a lack of correlation between our knowledge of the systematy of the tree and the anatomical structure of the wood, in the forestry of various parts of the British Empire. In his preface to this brochure, Prof. R. S. Troup, director of the Institute, remarks that no one has yet perfected an ideal form of description of wood anatomy. The subject is complicated by differences obtaining in different parts of the section, and by the considerable range in the dimensions of individual elements even at the same point in a tree; but with the development of a uniform system it should be possible approximately to determine a species from adequate material of the timber.

The present publication deals with some important east tropical African timber trees, *Juniperus procera* and *Podocarpus gracilior* and *milanjianus*, which form the cedar forests especially on Mt. Kenya, and *Widdringtonia Whytei*, the Milanje cypress, which with *Podocarpus milanjianus* characterises the forests of Mt. Milanje in Nyasaland. Descriptions are also given of ten species belonging to the family Leguminosæ of greater or less importance commercially. Good botanical descriptions of the species are included, with notes on distribution, climatic conditions, etc., but the most valuable feature is the detailed description of wood structure. The illustrations showing habit of the tree, anatomical structure, leaf and floral characters, are a helpful feature, and the introduction of keys to the African species of the various genera will be welcomed by the working botanist or forester. Incidentally, we commend the decision of the authors to regard the East African *Widdringtonia* as generically distinct from the Australian *Callitris* and the North African *Tetraclinis*.

The success of the task undertaken by the editors—the systematic description of the trees and woods of the Empire—will depend largely on a supply of reliable material and on the collaboration of workers with local experience in various parts of the Empire. A. B. R.

The Book of Amber. By Dr. George C. Williamson. Pp. 268 + 5 plates. (London: Ernest Benn, Ltd., 1932.) 15*s.* net.

MR. HERON-ALLEN's catholicity of interests includes the study of some aspects of amber; and he therefore very appropriately contributes a foreword to Dr. Williamson's most admirable book upon the origin, history, characters, distribution, and uses of this remarkable fossil resin from pines and other trees. It is, indeed, strange that, with the exception of some rare booklets and scattered papers or incidental chapters in other works, no general monograph of this kind, bringing together everything of interest concerning amber, has been published. Dr. Williamson writes with expert knowledge of his subject, and has devoted his leisure time over a period of twelve years to the compilation of his book. We join with Mr. Heron-Allen in a "tribute of admiration" at the result.

Among the subjects surveyed are classical allusions to amber; prehistoric amber routes in Europe; remains of plants, insects, and other creatures enclosed in amber; folklore, and medical uses; mineralogical characteristics; types, the chief of which are represented in a beautiful coloured frontispiece; tests; and pressed amber. The bibliography near the end of the book shows that Dr. Williamson is familiar with practically every work or paper relating directly or indirectly to amber. It may be of interest to recall in this connexion that Mr. Minakata described in NATURE of Jan. 24, 1895, Chinese theories of the origin of amber, including the resin of pines, and that Mr. Murray Stuart gave reasons in the issue of Jan. 20, 1923, for believing that some specimens of pale Chinese amber represented fossilised dammar—a resinous substance produced by certain bees.

Recent Advances in Materia Medica: being a Description of the Methods of Preparing and Testing Sera and Vaccines, Hormones and Vitamins, with an Account of their Properties and Medicinal Uses. By Dr. J. H. Burn. (The Recent Advances Series.) Pp. x + 224. (London: J. and A. Churchill, 1932.) 12*s.* 6*d.*

IN this volume of the "Recent Advances" Series, the author has confined himself to a consideration of some of those substances of value in therapeutics which are obtained from animal sources or require the use of animal tests of toxicity and potency before issue. The work is intended chiefly for students of pharmacy, and therefore includes certain elementary physiological details. It covers a field, however, of increasing importance; and its pages make available in small compass much information which ordinarily could only be obtained by a search of the original literature or a larger book dealing with biological assays. For this reason it can be recommended to physiologists and pharmacologists, as well as to medical practitioners who may wish to have some knowledge of the methods of preparation and test of biological products. The specialist may also find it useful for information on the subject of the biological assay of substances with which he may have had no recent experience.

The earlier chapters deal with antitoxins, sera, and vaccines; the middle section is devoted to the hormones, liver extract, and the arsenobenzene group of compounds; in the final chapters the uses and tests of the vitamins are considered. In the last two chapters the application of the results of biological tests to human beings and the principles of biological methods are discussed. The volume gives a readable account of a subject which is related to many branches of medical science, and therefore likely to be neglected except by the specialist.

The Statesman's Year-Book: Statistical and Historical Annual of the States of the World for the Year 1932. Edited by Dr. M. Epstein. Sixty-ninth Annual Publication, revised after Official Returns. Pp. xxxiv + 1474. (London: Macmillan and Co., Ltd., 1932.) 20*s.* net.

THIS valuable volume with its mass of carefully revised statistical information appears with its usual regularity. The arrangement follows that of previous years, and the size of the book is essentially the same. No new States have made their appearance, though the cession of Manchuria occurred in time to be noted among the addenda. New population figures are given for Great Britain, Canada, France, Italy, and many other States the census of which fell in the year under review. In order to indicate more clearly the trend of trade of Great Britain with other countries, re-export figures have been added to the tables summarising the trade of each country. The usual introductory tables are given of world production of petroleum, coal, iron and steel, gold, etc. The two coloured maps show respectively the railways of Manchuria (now Manchow-kuo) and the Zuider Zee reclamation. In the latter, the completion of the North-west Polder marks the success of the first step in the scheme. The lists of books, official and non-official, given for each State are one of the most useful features of this reference volume.

Electrical Machinery and Apparatus Manufacture: a Complete Work by Practical Specialists describing Modern Practice in the Construction and Manufacture of Apparatus and Machinery. Edited by Philip Kemp. In several volumes, by various authors. (London: Sir Isaac Pitman and Sons, Ltd., 1931–32.) 6*s.* net each vol.

THESE volumes are nicely bound, of convenient size, and are clearly printed. They are not intended to replace existing textbooks, dictionaries, or encyclopædias. They may prove useful to experts in particular branches of electricity who desire to supplement their knowledge of the actual construction and manufacture of electrical machinery and apparatus. We liked the section on works organisation and administration by A. P. M. Fleming. The section also on accumulator construction and manufacture contains practical information not easily found elsewhere. The descriptions given range from heavy machinery down to the manufacture of thermionic valves.

Prof. Planck and the Principle of Causality in Physics*

By Dr. Allan Ferguson

THE Guthrie lecturers before the Physical Society have in the past covered a wide range of knowledge in physical science, but they have very definitely concerned themselves with concrete problems. Atomic nuclei, electrodeless discharges, the properties of the elements under high pressures, the scattering of X-rays in gases, positive rays —these are typical of the subjects which have been discussed and illuminated by distinguished lecturers in past years. It has been left to Prof. Max Planck to treat with wide scholarship and philosophic insight one of the most difficult of the problems known to the thought of any age—that of the meaning and validity of the concept of causality.

It was a singularly happy chance which dictated the choice of this topic to Prof. Planck, for he, as much as any other living thinker, has forced upon the minds of the rank and file of physicists the necessity for some measure, at least, of metaphysical knowledge, and has roused us from that attitude of crude realism typified by Johnson, who, required by the insatiably curious Boswell (on Harwich beach, of all places) to criticise Berkeley's idealism, "answered, striking his foot with mighty force against a large stone till he rebounded from it, 'I refute it *thus*'". Nor must it be imagined that this simple attitude was a prerogative of the privates in our army. The habit of mind was to be found in very high places. Thus, turning to a lecture on the wave theory of light by the late Lord Kelvin, we find therein the very definite and uncompromising statement: "You can imagine particles of something, the thing whose motion constitutes light. This thing we call the luminiferous ether. That is the only substance we are confident of in dynamics. One thing we are sure of, and that is the reality and substantiality of the luminiferous ether." Less than fifty years have passed since these words were spoken, less than twenty-five since the speaker died; and the onset of the revolutionary change which has come over our physical thinking is marked by a paper published during Lord Kelvin's lifetime under the name of Max Planck in the last year of the nineteenth century.

It is impossible, and undesirable in the scope of a short article, to attempt an exhaustive review of the development of the concept of causality, but it is not without interest and bearing on present-day thought to consider briefly the development of the concept since the age of Newton. Locke, Newton's elder contemporary, states a clear and simple view, which, however, scarcely touches the fringe of the problem, when he says: "Thus, finding that in that substance which we call *wax*, fluidity, which is a simple idea that was not in it before, is constantly produced by the application of a certain degree of heat, we call the simple idea of heat in relation to fluidity in wax the *cause* of it, and *fluidity* the effect. . . . So that whatever is considered by us to conduce or operate to the producing any particular simple idea, whether substance or mode, which did not before exist, hath thereby in our minds the relation of a cause and so is dominated by us." The notion of *power* in this definition of cause is particularly evident.

The mind of Newton, as Prof. Brodetsky has recently remarked, was dominated by the principle of causality, and he was ever searching for a physical picture which should represent the results of his investigations. This is very true; but it is to be remembered that in this, as in so many other matters, Newton displayed a philosophic breadth of view which was well in advance of the doctrines of his day. He makes, for example, a physical picture of matter as formed in "solid, massy, hard, impenetrable, moveable particles", and assumes that they have not only a *vis inertiae*, but are moved by certain active principles, such as gravity. These principles are to be considered "not as occult qualities . . . but as general Laws of Nature . . . their Truth appearing to us by Phænomena. . . . To tell us that every Species of Things is endowed with an occult specifick Quality by which it acts and produces manifest effects, is to tell us nothing; but to derive two or three Principles of Motion from Phænomena and afterwards to tell us how the Properties and Actions of all corporeal Things follow from these manifest Principles would be a very great step in Philosophy, though the Causes of those Principles were not yet discovered; and therefore I scruple not to propose the Principles of Motion above mentioned, they being of very general extent, and leave their Causes to be found out." Evidently despite, or perhaps it would be better to say, along with his physical picture, Newton takes the view that we have made an important step when we have subsumed a number of perceptual facts under one general formula.

Although he may be indebted to Glanvill and other earlier writers, it is to Hume that we owe the first clearly ordered statement of the experientialist doctrine of causation. Such a generalisation, applied to a falling body, as "the earth attracts the stone", is explained as a generalisation from thousands of such observations. "Adam . . . could not have inferred from the fluidity and transparency of water that it would suffocate him, or from the light and warmth of fire that it would consume him. No object ever discovers by the qualities which appear to the senses, either the causes which produced it or the effects which will arise from it; nor can our reason, unassisted by experience, ever draw any inference concerning real existence and matter of fact." So, basing his argument entirely on experience, Hume defines a cause as "an object, followed by another, and

* Seventeenth Guthrie Lecture before the Physical Society, delivered by Prof. Max Planck on June 17.

where all the objects similar to the first are followed by objects similar to the second. Or, in other words; where, if the first object had not been, the second had never existed."

We may note here that the experientialist position was, in the nineteenth century, further developed by Mill, who states that the law of causation "is but the familiar truth that invariability of succession is found by observation to obtain between every fact in nature and some other fact which has preceded it, independently of all considerations respecting the ultimate mode of production of phenomena, and of every other question regarding the nature of things in themselves". Mill, moreover, meets the objection urged by Reid that on such a doctrine of succession, day must be the cause of night and vice versa, by pointing out that invariable sequence does not necessarily involve the notion of causation. To involve this last-named notion, the sequence must be *unconditional* as well as *invariable*. The day-night sequence obviously does not conform to this test, inasmuch as it is conditioned by the behaviour of our luminary, the sun. "We may define, therefore, the cause of a phenomenon to be the antecedent, or the concurrence of antecedents on which it is invariably and unconditionally consequent."

Kant's discussion of causality, wherein he takes the position that we could never make such a generalisation as "the earth attracts the stone" unless we had knowledge *a priori* and independent of experience that each event in our perceptions has its cause, has great importance in the history of philosophic thought: here we may pass it without comment, inasmuch as Kant's views have not played any decisive part in the development of scientific theory in this or in the last century.

Nineteenth century science, indeed, and specially nineteenth century English science, was in many ways, naïvely realistic; models played a large part in its development, and, while a model may serve a very useful end if it is thrown on one side, as Maxwell discarded his models, when it has fulfilled its purpose, there are, as we have already seen, serious dangers ahead when the model is elevated to the dignity of a 'reality'. None the less, a movement was on foot, owing much to Mach in Germany, and to Pearson in England, which, had its followers been greater in number, would have eased the path of many a physicist who, harassed by the conflicting claims of determinists and indeterminists, exclaims, "A plague on all your houses—let us go and make experiments". Kirchhoff had the root of the matter when he wrote, "Die Mechanik ist die Wissenschaft von der Bewegung; als ihre Aufgabe bezeichnen wir: die in der Natur vor sich gehenden Bewegung *vollständig* und *auf die einfachste Weise* zu beschreiben".

We live in a world of perceptions; sense impressions come and go; and we find that we can regularise these impressions if we devise a *conceptual* world of atoms and molecules, from which we build up particles and molar masses the behaviour of which corresponds to the routine of our sense impressions. Given a frame of reference, we can formulate laws of motion for two isolated particles in a conceptual world, which may be summed up in the statement that whatever the relative positions of the particles, the *ratio* of their accelerations is always found to be constant; we define this ratio as the inverse mass-ratio of the particles; and since in virtue of this we have the relation that

$$\text{mass of } A \times \text{acceleration of } A = \text{mass of } B \times \text{acceleration of } B,$$

we agree to give the name *force* to this product and obtain the law that action and reaction are equal and opposite. Moreover, on the basis of such definitions, we can build up a structure of bodies in the conceptual world the motions of which, predictable under the descriptive laws formulated, will agree with the routine of our world of perceptions. We have, in fact, *explained* certain phenomena.

Obviously, such a scheme of explanation puts out of court at once all those arguments concerning the contrast between dead mechanisms and living wills so dear to the Victorian controversialist. It is purely a matter of the relative complexity of the descriptive laws; one set of astronomical perceptions are subsumed under laws of comparative simplicity; another set of perceptions in the realm of biology requires a more complex scheme for its description. It may or may not be that in the future the two sets of perceptions may be described in terms of a common formula, but the difference, as Prof. Pearson says, is rather "quantitative than qualitative; the descriptions of mechanics are simpler and more general than those of biology". Evidently in such a description the idea of cause as involving power is out of place, and the definition in terms of invariable (and unconditional) succession as developed by Mill is also here appropriate.

Such, then, were the views concerning causality and scientific explanation which had been developed when the twentieth century and the quantum theory came into being. How have they been modified by the discoveries of the last generation?

This is the question which Prof. Planck sets out to answer, and, alive to the fact that most controversies, in the absence of exact definitions, tend to degenerate into logomachies, he seeks for an exact definition of the causal condition and finds it in the statement that *an event is causally conditioned if it can be predicted with certainty*. Prof. Planck goes on to remark that this statement has to be taken to mean that the possibility of making a correct prediction forms an infallible criterion for the agency of a causal connexion, but not that the two mean one and the same thing. In daytime, he remarks, we can predict with certainty the advent of night; but day is not the cause of night.

Prof. Planck then points out that, nevertheless, we assume a causal connexion in cases, for example, weather forecasting, where a correct prediction may not be possible, though in a case such as the last named the unreliability may be determined by the complicated nature of the object considered. In this part of his address, the compression of the

thought has led to obscurity which may give rise to misinterpretation. Any event which may be predicted with certainty is in the universe of causally conditioned events. This latter universe, we note, may be coterminous with or greater than that of predictable events. If we interpret Prof. Planck rightly, the statement has to be taken at its face value and gives no indication of the *sequence* of conditioned events—no indication, that is, of the *two* events which stand to each other in the relation of cause and effect. Thus, *day* is an event which may be correctly predicted in the night-time; all that we assert, then, is that day is a causally conditioned event, not that there is, or is not, any causal connexion between day and night. This definition, in its condensed form, is so different from those advanced by other philosophers, who are concerned, in a definition of cause and effect, with an invariable *sequence* of events, that it should be carefully examined in the light of the arguments of Hume ("Enquiry concerning Human Understanding", Section vii.) and of Mill ("Logic", Book iii. Chap. v.).

Taking the phrase as it stands, we find that, in the realm of quantitative physical events, however simple the event, however delicate our instruments, we cannot calculate *accurately* in advance the result of our measurement—that is, in no single instance can we predict infallibly a physical event. Hence the dilemma—if we adhere to our definition of causality—there is *no* physical event which is causally conditioned, and we become indeterminists, asserting that not one of the laws of Nature is absolutely valid, not even the law of gravitation; the appearance of validity is illusory, and the laws are laws of probability. If, rejecting this indeterminist picture, we endeavour to retain the concept of causality, we find it necessary to introduce some modification into our fundamental definition of causally conditioned events; and that modification is made by transferring the definition to a conceptual world in which exact measurements may be made and events correctly predicted. The mechanism of this conceptual world, and the process of connecting two events in the world of perception by the use of the conceptual picture, fully agree with that previously outlined, and it would seem that the adoption of the theories of Mach and of Pearson would enable us, even while recognising that an unavoidable uncertainty is attendant on the prediction of an event in the perceptual world, to retain the concepts of causality as accurately valid in our conceptual picture, the relation between perceptual and conceptual events being subject to a slight inaccuracy in the process of translation from the conceptual world to the world of sense impressions.

More than this; in the region of gas-kinetic theory—a domain which, more than any other, might be regarded as a happy hunting ground for the indeterminist seeking a description based entirely, even down to the collisions of individual molecules, on statistical laws—the principle of causality won one of its greatest triumphs: for it has been found possible to build up in the conceptual world a strictly causal mechanism, the conclusions drawn therefrom, on transference to the world of sense impression, giving a remarkably accurate picture even of those irregular fluctuations which are the chief hope of the indeterminists.

How is this state of affairs modified by the introduction into our concepts of the quantum of action and of Heisenberg's uncertainty principle, which states that the product of the uncertainties of, for example, the position and momentum of a particle is constant, so that any gain in accuracy of the one determination is balanced by a corresponding loss in accuracy of the other? Here again a new conceptual world of quantum physics may be framed in which a strict determinism reigns, and the problem of transfer between this world and the world of sense impressions is philosophically identical with that of our classical problem. In actual fact, it is more difficult; for the symbols of our classical conceptual world bore some resemblance to the routine of our perceptions—our mechanism of billiard ball atoms and the like was based on our everyday sense impressions. The wave function is not so easily interpreted in terms of the world of sense. It does not refer to ordinary space; it does not give the values of the co-ordinates as functions of the time, but gives the probability that the co-ordinates will possess given values at a definite time—a position which gives an obvious loophole for the indeterminist.

So we find a continual sway between determinism and indeterminism. For the indeterminist the statement that the wave function is a probability function is sufficient and satisfactory; laws such as the law of gravitation present to him unsolved problems to which he must find exceptions, calculating the probability that the force will diverge from the inverse square law by a certain definite amount. For the determinist, the inverse square law is a law of Nature, and he puts up with the probability function only as a *pis aller*, to be resolved later into relations subject to law.

Prof. Planck's test of the relative value of the two positions is a pragmatic one—there is nothing for it, he says, but to adopt one of the two points of view and to see whether we obtain valuable or useless results. At the moment, in his opinion, the indeterminists are in the majority, but, while he holds the balance with remarkable fairness, it is not too much to say that his sympathies are with the advocates of causality. Nowhere does he show this sympathy more deeply than in a daring final speculation. After reverting to the fundamental propositions that an event is causally conditioned if it can be infallibly predicted and that in no single case is it possible to predict an event accurately, he points out that we retained the principle of causality by modifying the *event*—by referring this to a conceptual world.

Since, however, all predictions imply a predicter—since the certainty of a prediction depends in a high degree on that predicter—suppose we modify the subject of prediction, the predicting mind, and assume an ideal mind capable of apprehending in their minutest details all the physical occurrences of the

universe: we have here a 'conceptual' mind which would predict accurately all physical events. What the good Bishop Berkeley would think of this, we do not presume to say; the speculation is fascinating, even though, as Prof. Planck remarks, in order to accomplish such a notion we must subject ourselves to a severe restriction—we must forgo making the ideal mind the subject of a scientific investigation.

Although Prof. Planck's conviction, that the law of causality is, in spite of the difficulty of a general proof or disproof, a valuable sign-post to guide us through the tangle of perceptions in which we live, shows the direction of his own sympathies, he does not suggest that the answer he had given to the question originally raised is more than a tentative one. But, tentative though the answer may be, the question has provoked a brilliant, thoughtful, and stimulating address, which will live long in the memories of those whose privilege it was to be present at the Guthrie Lecture for 1932.

Jérôme de Lalande, 1732–1807

THE absorbing interest felt by the general reader in the outstanding men and events of the French Revolutionary period is to a great extent experienced by the student of the lives and characters of the French men of science who laboured during that remarkable time. During the latter part of the eighteenth century Paris was the centre of amazing intellectual activities, which even the vicissitudes of the most perilous days could not quench, and which, after the worst dangers were past, were resumed with increased zest. Especially was this the case with scientific studies and instruction. Old institutions of which the very life had been threatened were reorganised, and beside them sprang into existence others destined quickly to rival in renown any that had gone before. To one or other of the many institutions belonged most of the eminent men of science of France, among whom were Laplace, Lagrange, Delambre, Monge, Haüy, Berthollet, Chaptal, Coulomb, Lacépède, Lamarck, and last but not least, the astronomer Lalande, the bicentenary of whose birth occurs this month.

Joseph Jérôme Lefrançais de Lalande was born at Bourg-en-Bresse in the department of Ain, on July 11, 1732, and died in Paris on April 4, 1807, in his seventy-fifth year. Never in need of labouring for his daily bread, his life was yet one of unceasing effort, and from the time when as a boy he came under the Jesuit schoolmasters at Lyons until old age came upon him, his industry was remarkable. It is true that as an astronomer he has never been reckoned in the first rank as a discoverer or an investigator, but as an exponent of astronomy and a populariser of science he has had few equals. His industry is attested by the list of more than two hundred memoirs and books he wrote, but much of his influence on the progress of astronomy was due to the lectures he gave during the forty-six years he held the chair of astronomy at the Collège de France and to his encouragement of students. Though no great discovery stands to his credit, by his writings and lectures he gained for his favourite science a popularity previously unknown, and it is for that he is chiefly remembered.

Lalande's interest in astronomy is said to have been aroused by seeing a comet and watching an eclipse, and to have been further stimulated by reading Fontenelle's "Plurality of Worlds". It was, however, his contact with Delisle and Lemonnier which led him to abandon the law courts for the observatory, and it was through Lemonnier that as a youth of nineteen years of age he was sent to Berlin to make observations simultaneously with those being made at the Cape by Lacaille for determining the parallax of the moon. From the court of Frederick the Great and the society of Euler, Lalande returned to Paris and at the age of twenty-one was given a place as 'adjoint-astronome' in the Paris Academy of Science. He became an 'associé' in 1758 and a 'pensionnaire' in 1772.

With the account of his work at Berlin began the long series of memoirs referred to. A few years later, for Clairaut he made a mass of calculations in connexion with the predicted return of Halley's comet; in 1761 he succeeded Maraldi as editor of the "Connaissance des Temps"; in 1762 he succeeded to Delisle's chair at the Collège de France, and in 1764 he published the first part of his "Traité d'astronomie". Other parts followed in 1771 and 1792. "This compilation", wrote Thomas Young, "far excelled in utility all former works of the kind, and will always be considered as exhibiting the most perfect picture of the science such as it existed from 1760 to 1790 with all the details of practice and computation." Lemonnier called Lalande's work "the great newspaper of astronomy". Another notable work of Lalande was his "Histoire céleste", published in 1801, giving the places of 47,390 stars, the observations for which were made chiefly by his nephew Michel Lalande and D'Agelet, both of whom he had instructed.

The character of Lalande was no less interesting than his work. It was once said of him that he was as anxious to direct attention to himself as an individual as to astronomy as a science. His love of flattery and publicity was undeniable; but he possessed many admirable traits. Generous to a fault, he encouraged and provided for many young and needy students, and during the Revolution his courage led him to protect others at his own risk. He visited England in 1788, conversed with George III., crawled through Herschel's great telescope at Slough, and it was due to him that Herschel's newly discovered planet, Uranus, was for a time called after its famous discoverer. Living abstemiously himself, he placed his fortune at the disposal of others, and towards the end of his life founded the Lalande medal, which became the 'blue ribbon' of the astronomical world. Quite early in his career, in 1763, he was made a foreign member of the Royal Society, while the esteem in which his memory is still held in France was shown by the inauguration in 1909 of a monument to him at his birthplace, Bourg-en-Bresse.

New Buildings for the University of London

FRIENDS of university education throughout the world will welcome the announcement contained in an official publication of the University of London entitled, "New Buildings on the Bloomsbury Site" (pp. 18, illustrations and map), that the architect, Mr. Charles Holden, selected and appointed by the Court of the University, has completed a model of the proposed University buildings. We reproduce a photograph of the model (Fig. 1), kindly supplied by the University, and of the air photograph of the site (Fig. 2), which forms the frontispiece of T. Ll. Humberstone's "University Reform in London" (Allen and Unwin, 1926). The pamphlet is designed to give "a short account of the work of the University, of its present location and of its aims and aspirations". Not an appeal for funds! That will come later, and the University is confident, we are told in a "Foreword" signed by the Chancellor, the Earl of Athlone, and the other high officers of the University, "that in due time money will be forthcoming from its friends and from all who esteem learning and scholarship".

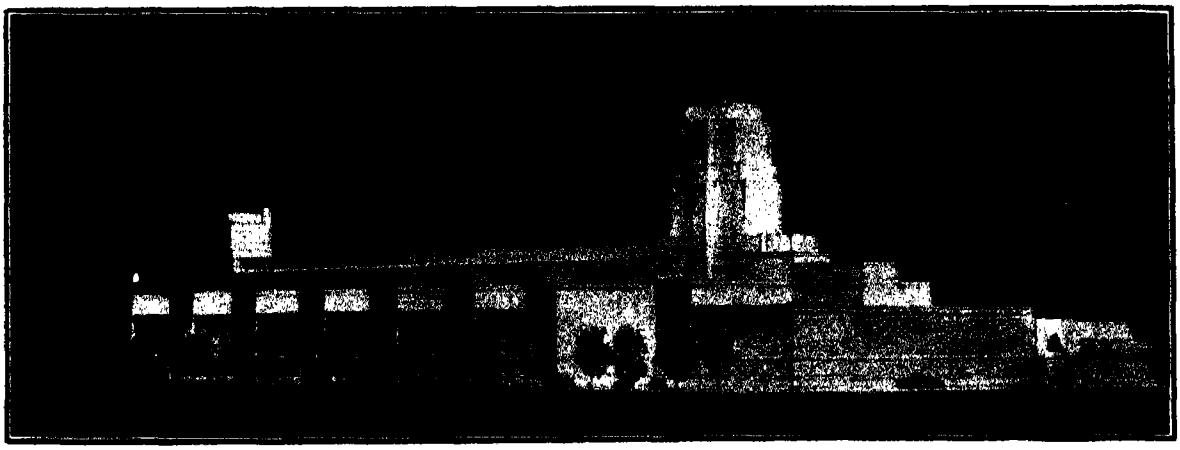


FIG. 1.—View of a model of the proposed buildings in Bloomsbury for the University of London, showing the main features of the general design.

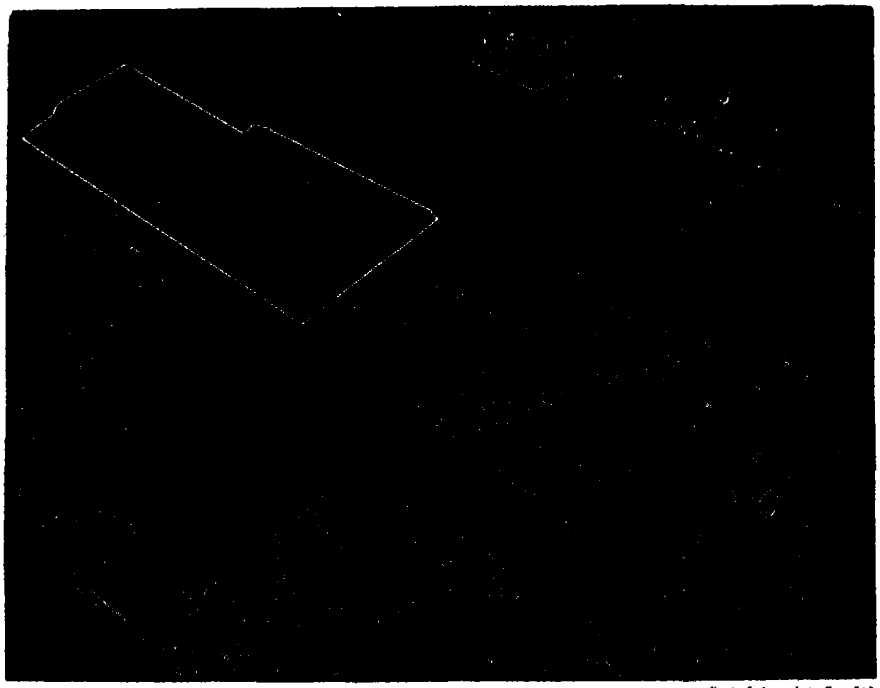
How peculiarly Victorian is the early history of the University of London! Founded in 1836 by Royal Charter, the University was in one sense a Government bureau, accommodated, rent free, in quarters provided by the Government. "For some thirty years", the writer of the pamphlet states, "it discharged its modest duties in modest apartments in Somerset House. From 1870 to 1900, it had a home of its own when it was housed in a building erected at the expense of the Government in Burlington Gardens, now occupied by the Civil Service Commission." The point is not of essential importance, but this account of the early migrations of the University does not tally with that given in the Calendar (1928–29). "From the beginning", we are there informed, "the Government accepted the responsibility for housing the University, and at first apartments were provided in Somerset House, which were also occupied by various learned societies; but in 1835 the Senate were deprived of these and housed in what was described as a '*miserable garret in Marlborough House*'. This accommodation was of a temporary nature only, and in the spring of 1855 the University again removed this time to Burlington House."

Powerful influences were brought to bear on the Senate of the emancipated University—it was reconstituted as a teaching university under the Act of 1898—to induce it to agree to the removal of the University headquarters to the partially derelict building of the Imperial Institute at South Kensington. Without any question the accommodation offered in that beautiful building was in many ways superior, especially for examinations. H. G. Wells used his caustic pen to denounce the old University building, dusty, desolate and empty, the thin permanent odour of dogfish and rabbits pervading the library, in which practical examinations were held; and to express his surprise that any person should oppose any sort of reform for the University of London. Moreover, the accommodation in the Imperial Institute was much more extensive, and this no doubt explains the famous Treasury minute of Feb. 16, 1899, giving a guarantee that the accommodation to be provided would include "such provision as may hereafter be needed for the full extension and development of the University under the Statutes and Regulations made by the Commissioners appointed by the Act". This carelessly worded minute proved troublesome in later years. As a fact, when immediate administrative needs were satisfied, there remained a whole floor, and this was used, not very appropriately, as a research laboratory for physiology, directed for many years by Prof. A. D. Waller. When the accommodation problem became acute, the laboratory was abolished *sans phrase*, the staff pensioned, and the valuable apparatus given away. Perhaps it was well that Dr. Waller did not survive to see this *débâcle*! The point to be emphasised is that

the University always held the Government to its obligation to provide adequate accommodation for its administrative work.

Of course, the real question was not one of providing comfortable rooms for a number of University officials and their clerks, for meetings of committees, and for the examination of candidates. This was recognised by the Royal Commission on University Education in London, appointed in 1910, generally known as the Haldane Commission. So impressed was the Commission by the inadequacy of the administrative headquarters of the University in the Imperial Institute that this question was made the subject of a special preliminary report dated Dec. 15, 1911. One would have expected that on the sound principle enunciated by the cookery book author, " First catch your hare ", it would have appeared expedient to the Commissioners to ensure the reconstitution of the University, and to define its new duties, before considering the question of accommodation, a matter not directly within their terms of reference.

The Haldane Commission in its preliminary report strongly urged that a site should be secured of sufficient size to allow a large measure of freedom in determining the nature of the buildings to be erected, including such scientific institutes as had been referred to earlier in the Report, if these should be found to be necessary or desirable. Both in the public interest and in the interest of the University, the Commission said, buildings should be erected for a reconstituted University, " which would be a visible sign of its recognition as a great public institution ". Be it understood, however, that the Commission at this stage did not recommend the Bloomsbury site. Apparently a friend of Lord Haldane's made investigations, and was able to convince him that this was the most suitable site—at this time it was the 2½ acres forming the southern part of the site—whereupon, having secured the personal approval of Lord Rosebery, Chancellor of the University, he began to collect money for the purchase of the site. These proceedings caused much dissension within the University. On Presentation Day (May 7, 1912) the Principal, Sir Henry Miers, was able to announce that £355,000 had been offered towards site and buildings. Alas! those golden sovereigns have been used for other purposes. Many alternative sites were considered, notwithstanding the view expressed by the Haldane Commission in its Final Report dated March 27, 1913, that the most suitable and convenient quarters for the central University buildings would be found in Bloomsbury. Guerrilla warfare was maintained until the outbreak of the War of 1914–18.



Central Aerophoto Co., Ltd.

FIG. 2.—British Museum and the site (enclosed in a white line) of the University of London. From " University Reform in London ".

We do not question the wisdom of the writer of the pamphlet in scattering the poppies of oblivion over the period 1911–1932, years of controversy, of war, of reconstruction—assuredly years of great progress in university education in London. Twenty have passed before the Royal Commission's dream has taken form and substance in an architect's model; and Lord Haldane and most of his colleagues, including Lord Milner, Sir Robert Morant, and Sir William McCormick, have not survived to see this Pisgah-view. If we lift the veil, it is to honour those to whom they handed the torch—particularly Mr. H. A. L. Fisher, who in 1920, while president of the Board of Education, moved the Government to offer the site to the University. " The Government ", he wrote on April 7 of that year, " are now in a position to acquire a site of about 11½ acres behind the British Museum, and they offer to devote it gratis and in perpetuity to the provision of a site for new headquarters of the University and for colleges and institutions connected with it, including King's College, whose premises in the Strand are now inadequate for its needs." After the five years' grace allowed by the Government, the University found it could not satisfy the conditions attached to the gift, particularly in regard to the removal of King's College, and therefore refused the site, which was re-sold to the Duke of Bedford. It was a black

day for the University, perhaps the blackest in its history. But as Mr. H. V. Lanchester wrote (*New Troy*, June 3, 1926):

"So our Site has gone back to the Duke of Bedford. This does not mean that it might not yet be reclaimed if the will to do it were there. The Duke is in no way antagonistic to the scheme, and the only difference in the position is that the Government offer, to the value of half-a-million or so, is in abeyance, for it seems inconceivable that were a reasonable programme put forward, any Government would fail to offer substantial assistance."

The position soon became desperate. The Duke had signed a few long leases of houses on the site, some of which, we believe, still remain in alien hands, and was on the point of signing building leases. Victory was snatched from a stricken field by the Vice-Chancellor, Sir William Beveridge, who secured a most generous benefaction from the Rockefeller Foundation for the purchase of the site. In addition, a substantial contribution was made by the Government, which thus gained release from its putative obligation to provide for the housing of the University; and the London County Council, after coquetting with alternative sites, including Somerset House and Holland Park, offered openhanded co-operation for the Bloomsbury policy. On May 11, 1927, at the annual graduates' dinner, Lord Eustace Percy, president of the Board of Education, announced the purchase of the site. Let us remember with gratitude those who saw the vision—Gregory Foster, Haldane, Rosebery, Morant, McCormick—and congratulate those whose privilege it will be to transmute the vision into perdurable stone.

The dust of the site controversy has settled. The University is reconciled to Bloomsbury, even when it is described by the official historian of King's College as "an obscure and decaying suburb, off all the main lines of traffic and difficult of access"! But controversy follows controversy. For what purposes are these vast buildings to be used? We turn for information to the official pamphlet, not without misgiving. In addition to the administrative accommodation, there is to be a spacious and well-equipped library building, worthy of the treasures it will hold; and adjacent, but forming a part of the whole design, will be brought together a number of other University institutions. These include the Institute of Historical Research, the Courtauld Institute of Art, the School of Oriental Languages when it leaves its present building in Finsbury Circus, the School of Slavonic Studies, the Institute of Education (formerly the London Day Training College), and Birkbeck College. There will be a Great Hall, facing Russell Square, and accommodation for the Officers Training Corps and the University Union.

An ambitious programme—but the reader of NATURE will at once ask, what provision is to be made for scientific research? We have seen that the Haldane Commission in its preliminary report contemplated the possibility of scientific institutes. Before reaching the stage of the final report, other counsels prevailed. "Special research institutes", it declared, "should not form part of the University organisation." In the opinion of the Commission, the proposal supported by the Medical Committee of the British Science Guild for the establishment of post-graduate laboratories "would be full of danger to the development of the University". In a letter to the *Times* (Nov. 1, 1913), not long after the publication of the Final Report, Dr. A. D. Waller expressed an opinion which we believe will be generally shared by readers of NATURE. "My own opinion," he wrote, "confirmed by the experience of my last 12 years of work at the University—agrees with the opinion expressed in the report of Lord Cowper's Commission to the effect that the establishment of institutions for research was the only way in which existing defects could be supplied . . . and would not in any degree affect injuriously the course of ordinary teaching or discourage the spirit of research in the university schools, but would, on the contrary, promote throughout the university and its other institutions that zeal for the advancement of knowledge which is the highest mark and aim of university training." Nor are we told in the official pamphlet whether suitable and well-equipped lecture theatres are to be provided in the new buildings, where professors could give their inaugural lectures and foreign scholars could communicate the results of their researches. The Haldane Commission expressed a definite view on this question—"We are of opinion that several, though not a large number, of commodious lecture halls should be provided in the central buildings to be first erected". A school of law, a school of music, and a school of journalism are a few of the other institutions which might stake claims on the site.

Of the architectural merits of Mr. Holden's design, we cannot claim to express an expert view. Certain questions the layman, the *homme moyen sensuel*, may be allowed to ask. First, what reasons caused the University to abandon its declared policy of holding a world-wide competition for the best design—a graceful compliment to the most generous donor for the purchase of the site—followed by a competition limited to architects of selected designs and to a small number of architects specially invited to compete? That the Court of the University should take upon itself the selection of an architect is a procedure contrary to all the traditions of the University. Secondly, ought not the members of the University, and the public generally, to insist that the building shall express its idealistic purpose—that long tradition of the search for knowledge, Abelard drawing seekers after truth to Paris, *alma mater* of our universities; Roger Bacon in his tower on the Isis; Newton on the Cam "voyaging through strange seas of thought, alone"; Michael Faraday, London's own man of science, an original member of the Senate of the University of London, who could not afford to get rich, but added untold millions to the wealth of the world; Lister, a graduate of the University, of whom it has been said that no man has done more to relieve human suffering; Ramsay, a professor

of the University, discovering argon and helium in his laboratory at University College; Jeans, a member of the present Senate, peering over the edge of the universe. . . .

We do not suggest that the architect of the new University building should attempt to recapture —in Bloomsbury—the last enchantments of the Middle Age. If he succeeds in capturing the spirit of the present age, he will deserve his niche in the Pantheon of architects. Questions of style apart, air, sunlight, and accessibility are crucial in considering the design. Is it wise, from these viewpoints, to build a single huge building, possibly the largest in London, a break-air, if the word may be coined? Science has not yet discovered any effective method of ventilating a great building with numerous wings—witness the Houses of Parliament. On this question it is possible to appeal to expert opinion. Three distinguished architects in their lay-outs for the site have provided a forecourt and abundant internal air space.

Mr. H. V. Lanchester's sketch of "the University of the Future" showed a forecourt flanked by offices and library and facing the hall and institutes with a dome and two graceful towers. Prof. A. E. Richardson, professor of architecture in the University, adopted a somewhat similar lay-out in a brilliant impromptu sketch, the forecourt facing the Great Hall, not crowned with a dome or tower, a feature he regarded as wasteful and unnecessary. Prof. S. D. Adshead, professor of town planning in the University, prepared a sketch showing an open space running through the site north and south, broken only by arches. He did not consider there was sufficient space for a Great Hall. "Should a great hall ever be built in the neighbourhood," he said in a paper read to the Town Planning Institute (April 29, 1927), "I think it should occupy one of the adjoining residential blocks." This view has been endorsed by Mr. Holden, who has sited the Hall on the part of the site facing Russell Square. All these architects have recognised the importance of Sir John Burnet's columned northern extension of the British Museum in relation to the University building. Mr. Holden's design presents to this frontage of the Museum the least dignified part of its anatomy, as will be seen from the photograph. Whatever else may happen, this should be rectified. We should prefer, however, that the idea of a single great building should be abandoned and an alternative design adopted treating the problem in a more free and characteristic way. T. LL. H.

News and Views

Sir Joseph Larmor, F.R.S.

SIR JOSEPH LARMOR, whose resignation of the Lucasian professorship of mathematics in the University of Cambridge is announced, succeeded Sir George Gabriel Stokes in the chair in 1903. Stokes had been elected so long ago as 1849, and one of the early acts of his successor was to edit his "Scientific Correspondence" (2 volumes, 1907). After being Senior Wrangler in 1880 and first Smith's Prizeman, Mr. Larmor (he was knighted in 1909) was elected to a fellowship in St. John's College and was appointed professor of mathematics at Galway, but in 1885 he returned to Cambridge as College and University lecturer in mathematics. "Æther and Matter" appeared in 1900, and his election as secretary of the Royal Society in 1901 (he had been a fellow since 1892) was a recognition of his eminence as a mathematical physicist. Scientific papers have continued to flow from his pen since 1881 or before, but the long-hoped-for treatise on electrodynamic theory did not materialise. The works of many younger men, however, clearly show the inspiration which they derived from his lectures. In 1929 the Cambridge University Press published two handsome volumes of "Mathematical and Physical Papers", with Sir Joseph's own comments in the form of notes and appendices; a glance at the table of contents will give an idea of his enormous range of interests. In addition, his frequent letters in NATURE and elsewhere, though as a rule not easy to understand, have always been worth serious consideration.

THOSE who were privileged to be present will not readily forget the inimitable, racy address which Sir Joseph gave in the Arts School in Cambridge at the Clerk Maxwell Celebration in October 1931; it was quite different from the paper, "The Scientific Environment of Clerk Maxwell", published in the Commemoration Volume, and this in turn is only an extract from a more extended investigation into the historical origins of thermodynamics and the kinetic theory which, it is hoped, will soon be published. One of the duties of the Lucasian professor, as of the other professors of mathematics in Cambridge, is the reading of the essays submitted year by year for the Smith's Prizes; and thus Sir Joseph has kept constantly in touch with the best of the younger Cambridge mathematicians. Perhaps he has occasionally been a little out of sympathy with some of the recent developments in pure mathematics, but he has always been ready with advice and encouragement; in particular, the succession of Isaac Newton Students have reason to bless his name. From 1911 until 1922, Sir Joseph sat as member of Parliament for the University of Cambridge, and other administrative duties, in the University and elsewhere, have been thrust upon him and conscientiously discharged. A congenial office has been his chairmanship, in the absence of the Vice-Chancellor, of the Observatory Syndicate and the Solar Physics Committee in Cambridge; he always seems thoroughly to enjoy presiding over the body of distinguished men of science who assemble once a year to lunch with the professor of astrophysics and discuss the affairs of the Solar Physics Observatory. It is to be hoped that Sir Joseph's retirement from his professorship will not mean his leaving Cambridge, for his College and the University can still profit by his services.

Geological Society Elections

THE following have been elected foreign members and foreign correspondents of the Geological Society of London: Prof. R. A. Daly, Sturgis Hooper professor of geology in the Museum of Comparative Zoology at Harvard College, an authority on igneous rocks and mountain building and on coral reefs; Prof. Paul Niggli, University of Zurich, distinguished for his work on ore deposits and crystallography; and Prof. Bailey Willis, Stanford University, known for his work on geological structures, to be foreign members of the Society. Prof. C. P. Berkey, Columbia University, New York City, secretary of the Geological Society of America, who has carried out geological studies in Mongolia and elsewhere; Prof. H. A. Brouwer, University of Amsterdam, known for his work on the geology and petrology of the Dutch East Indies; Prof. Hans Cloos, University of Bonn, an authority on the tectonics of igneous intrusions; Prof. W. K. Gregory, curator in the American Museum of Natural History, New York City, distinguished for his studies on fossil vertebrates; and Dr. Victor Van Straelen, director of the Natural History Museum in Brussels, distinguished for his work on fossil Crustacea, to be foreign correspondents of the Society.

Beilby Memorial Awards

AWARDS are made from time to time from the interest on the Beilby memorial fund to British investigators in science for original work, preference being given to the investigation of problems connected with fuel economy, chemical engineering, and metallurgy. The administrators of the fund have just awarded £105 each to Mr. W. J. Rees, of the Department of Applied Science in the University of Sheffield, and Dr. W. R. Schoeller, metallurgist, Messrs. D. C. Griffith and Co., London. Mr. Rees was educated at George Dixon Technical School, Birmingham, and at the Royal College of Science, London. In 1901, he became assistant to Dr. Walter Rosenhain, in the laboratories of Messrs. Chance Bros. and Co., Ltd., at Birmingham; in 1906–17, he was chief chemist to the same company, and since 1917 he has been lecturer in charge of the Department of Refractory Materials in the University of Sheffield. He is an honorary member of the British Cast Iron Research Association, to which he was elected in recognition of services rendered in connexion with research on moulding sands; and hon. secretary of the Refractories Association of Great Britain. Dr. Schoeller was born at Antwerp and educated in Belgian State schools at Antwerp and Tournai. He studied chemistry at the Polytechnic Institutes at Darmstadt and Stuttgart, and at the University of Greifswald, where he obtained the degree of Ph.D. in 1902. In the following year, he joined the staff of Messrs. D. C. Griffith and Co., assayers to the Bank of England, and in 1909 was naturalised as a British subject. After experience in the United States, South America, China, and elsewhere, he rejoined Messrs. D. C. Griffith and Co., specialising in rare metals. From 1913 onwards, he has devoted much of his spare time to original research work, especially on tantalum and niobium. He is joint author with Mr. A. R. Powell, of "The Analysis of Minerals and Ores of the Rarer Elements".

The Peking Man

AT a meeting of the Geological Society of China on June 28, Prof. Davidson Black made the first public reference to the discovery of parts of *Sinanthropus* other than the skull—an ungual phalanx of the foot found more than two years ago, a clavicle and a semilunar bone (wrist) found last season. The announcement of these discoveries was withheld until the close of the present season's excavations at Chou Kou Tien in the hope that other parts of the limbs might be recovered. This hope has not been realised. Hence an account is now given of the small fragment that seems to demonstrate that the Peking man's hand "differed in no essential respect from our own", of the peculiar obliquely-directed toe-bone, which "makes it probable that the feet differed much more widely from ours than the hands", and of the robust clavicle. On July 5 Prof. Davidson Black left Peking for England to deliver the Croonian Lecture to the Royal Society next December; he is visiting fossil beds in India and Egypt on the way. Before leaving China, he made casts of the five jaw fragments, the complete skull of the youth found in 1929, and of the endocranial cast of *Sinanthropus*, for transmission to London for reproduction, and completed his report on the endocranial cast and its significance. Its capacity is not more than 900 c.c. It reveals the asymmetry claimed to be distinctive of right-handedness. The cast displays many primitive features of exceptional interest, which shed important light on the distinctive characters of the earliest human brain.

Women Graduates in Modern Life

AT the annual reunion on June 30 of the University of Edinburgh Graduates' Association, held in the Women's Union, Sir Josiah Stamp referred to the alumni associations in America as constituting one of the strongest sides of American university life, and said that he hoped the graduates of Edinburgh would similarly endeavour to make the University a real and active part in themselves, letting its influence remain with them and helping it in every way they could. Speaking more particularly to the women graduates, he reflected upon the gravity of the times in which we live and the tremendous importance and value of the collective mental training represented by the graduates who had just been 'capped', mobilised and conserved for the future. While it may be said that the careers of many of these women will be cut short and some people may say all they have done at the University would so be wasted, he considers that a wrong view. Why should not man and wife act together in the great task of thinking out the world's problems, thus making for a higher standard of civic and individual judgment than we have to-day?

The Universities and Civilisation

SIR JOSIAH was emphatic that civilisation is at the crossroads; it may go one way under the influence of mass desire and mass impression, or the other way under the influence of intellectual and moral leader-

ship. If a university is not a great force, if the members of a university are not a great force in that decision, then who is ? Where are we to look for it ? In this crisis in civilisation there is a terrific responsibility on university graduates for elasticity of mind, probity and clarity of judgment, and industry of thought on the concrete issue before them. There are many great issues on moral principles in these days, when the widely-held view is that the proper place for a path is the edge of the precipice. The world is full of good people who are thoroughly muddle-headed ; this is a time for level-headed decisions and carefully worked out ones. Sir Josiah concluded with a call to the students to be true to the great ideals the university has given them ; and to try to make the university what he believes it ought always to be—somewhere where the reasoned thought and soul of our country can have the perpetual association of great ideas, the discipline of serious and persistent aims, the purification of candid and purging humour, and lastly the company of souls that are kindled to noble purposes.

Society for Psychical Research

THE last of the jubilee meetings of the Society for Psychical Research was held on July 4 at the Conway Hall, when Dr. William Brown, Wilde reader in mental philosophy in the University of Oxford, lectured on "Psychology and Psychical Research". The president, Sir Oliver Lodge, took the chair. Dr. Brown said that hypnotic and psycho-analytic investigations have greatly supplemented the theory of the 'subliminal self' first propounded by F. W. H. Myers, one of the founders of the Society for Psychical Research, without, however, really supplanting it. The employment of the statistical method on large numbers of cases is entirely in the spirit of strict science, yet the predominantly negative results recently obtained along these lines as regards manifestations of telepathy and clairvoyance should not blind the public to the possibility of such phenomena in special cases and under special conditions. The intensive study of well-attested individual cases is needed to correct the balance, and it is especially along this line that the Society for Psychical Research has done much useful work. One might base one's belief in survival most firmly on general philosophical and religious considerations as to the nature and value of human experience ; nevertheless, the sum total of evidence of a scientific nature accumulated by the Society for Psychical Research in support of survival is far from negligible.

Marconi Beam Stations for Shanghai

NEW Marconi transmitting and receiving stations are to be erected near Shanghai for the operation of the proposed short-wave beam services between China and Europe and the United States. A unique feature of the installation will be the inclusion of auxiliary Marconi apparatus enabling the transmitters to be utilised for broadcasting services when they are not in use for telegraphic communications. The auxiliary apparatus for this purpose consists of a modulating equipment which can be connected to either of the telegraph transmitters to provide telephone signals of broadcasting quality. A complete set of Marconi studio equipment is also to be supplied to enable the service to be conducted in accordance with the most modern practice. The aerial system of the transmitting station is of particular interest. For the commercial telegraph services to Europe, of which the principal is the service to Great Britain, two bays of beam aerials, accurately oriented to concentrate their signals on the receiving stations, are to be erected, one being tuned to the wave-length of 17 metres and the other to 26 metres, the wave-lengths allotted to these circuits. A third beam aerial array will be directed on San Francisco for the American service. In addition, there will be four omni-directional aerials, one of which will be used for broadcasting. The others are provided to afford the station the maximum flexibility in the range and extent of its telegraphic services. At the receiving station four high-speed commercial service receivers of the Marconi beam type are to be installed, with two beam aerial systems directed on Europe and two on San Francisco. Four omni-directional receiving aerials are also to be supplied for the reception of short-wave signals from other countries with which beam services are not required. On the completion of these stations near Shanghai a direct commercial wireless circuit will be provided for the first time between Great Britain and China.

Emergency Lighting Sets

IN addition to the usual source of electric power for supplying lamps and signalling devices, it is sometimes necessary, in order to safeguard life and property, to have another source of power that can be available in emergency. Such additional sources are necessary for theatres, cinemas, hospitals, and for all large buildings through which there is a continuous stream of traffic. Up to the present time, storage batteries have often been used for this purpose, but their drawbacks are their expense and the gases they develop, often necessitating the use of a large separate room. A petrol electric set has sometimes been suggested, but there is frequently difficulty in starting it after a long period of standstill. Fire risks also impose restrictions in the selection of rooms for these sets. In a recent issue of *Allgemeine Elektricitäts Gesellschaft* (*A.E.G.*) *Progress*, a new emergency lighting set is described which eliminates practically all these difficulties. It consists simply of a small water turbine, which can be connected to the municipal water mains and drives a direct current generator (turbinamo). The water supply to the turbine is normally cut off. Should the normal supply voltage fall for any reason, an electro-magnet ceases to act and so a cut-off device is released, and the pressure of the water in the mains opens a valve and the machine rotates. The water pressure required is anything between 3 and 6 atmos. (42·5-85 lb. per sq. in.). The lighting set has a vertical axis, and takes up very little space. It should be placed near the water supply mains. As a disturbance rarely occurs, and lasts only very little time, the cost of the water used is negligible.

Mechanised Farming

"MECHANISATION and British Agriculture" was the subject of the fourteenth Conference held at Rothamsted Experimental Station, Harpenden, the full report of which has been published and can be obtained on application to the Secretary, price 2*s*. 6*d*. In these times of agricultural depression, the use of labour-saving machinery and implements is one of the most feasible means by which farmers may reduce their costs, and the appliances available and their probable lines of development are described by Mr. J. E. Newman, of the Oxford School of Agricultural Engineering. Successful practice in the new cereal husbandry is set out in a series of papers by leading farmers, the record of whose experience is of the utmost value. The question of live stock is not, however, overlooked, and Prof. J. A. S. Watson contributes a stimulating account of the combination of animal husbandry with mechanised farming. The maintenance of soil fertility under the frequent growth of cereals is the subject of a paper by Sir John Russell, who discusses, amongst other problems, the most economical means of restoring to the soil the surplus straw which is now an encumbrance on the large cereal farms. The booklet contains a full account of the discussion following the papers and a summary of the agricultural problems involved.

Prehistoric Pot-Boilers

MR. WILFRED L. BULLOWS, of Streetly, Warwickshire, adverting to a reference to flint pot-boilers by Sir Arthur Smith Woodward in his article on fossil man in China (see NATURE, May 28, p. 784), writes to point out the unsuitability of flint for this purpose. In the course of an investigation of a prehistoric cooking site in Sutton Park, Warwickshire, in 1926, Mr. Bullows carried out a number of experiments with the view of ascertaining the methods probably employed in making use of several cooking pits which had been discovered on the site under mounds of broken stone of an undoubted antiquity. On a considerable area of ground laid bare by a fire which had taken place a few years previously, there were found not only a number of cooking pot-holes, oval in shape and of an original depth of about 1½ ft., but also hearths for heating the stones, as well as ridges of stone, which probably represented the clearings of the cooking pots. The pot-holes had not been lined with clay; but evidently undressed skins had been used as a lining, the shape of the hide probably being responsible for the oval shape of the pit. In a trial in a small pit lined with a sheepskin, it was found that four gallons of water could be raised to boiling point with heated stones in about forty minutes. Fifty pounds of stones, each weighing from two to three pounds, were required. The stones used here by prehistoric man were quartzite pebbles from the Bunter pebble beds, and the same kind of stone was used in the experiment. Flints were found to be useless, as not only did they split alarmingly in the fire, but sudden contraction in cold water reduced them almost to powder. A report by Mr. Bullows on his investigation of this interesting site in Sutton Park and its bearing on methods of cooking by the use of heated stones appeared in *Trans. Birmingham Archæol. Soc.*, vol. 52, pt. 2, 1927.

Egypt Exploration Society's Exhibition

THE exhibition of archæological finds during the past season, now open at the Wellcome Historical Medical Museum, Wigmore Street, London, covers the work of the expeditions of the Egypt Exploration Society at Abydos, Amarna, and Armant. At Abydos, the Society, working in co-operation with the Oriental Institute of Chicago, is engaged in copying the frescoes of the temple of Seti. The work is in the hands of Miss A. M. Calverley and Miss M. F. Broome, who contribute a magnificent series of paintings as the result of their activities during the past winter. The exhibits from Amarna include a number of photographs, some taken from the air; frescoes which have been restored skilfully; statuary of the age of Akhenaton, mostly broken by his successors, and profiles engraved on limestone, which are thought to be sculptors' trial pieces. Among the other miscellaneous objects included from this site are glass, pottery, and ostraka of the Roman period. At Armant the most remarkable finds were the predynastic plaster 'flags' already familiar from the published description by Mr. O. H. Myers, director of the excavation. Slate palettes, black-topped ware in remarkably good preservation, other pottery, and flints are of a more familiar character than painted skulls and two hippopotami in pink limestone which accompanied them.

Habits of the Pangolin

How the Indian pangolin combines attack with defence is told by Mr. W. G. Adam in the *Field* for June 11, p. 882, in an article on the species as studied by him in Ceylon, of which island it is a native. When rolled up in the defensive position with its tail turned forward, it keeps up a slapping and grinding movement with that member, and if this results in any part of the assailant's body being caught between its own body and tail, begins a sawing movement of the latter which, the scales of the body and tail being opposed in the rolled-up position, inflicts a severe wound. Whether this act be due to instinct or intelligence, the pangolin seems to be an animal of fairly high mentality and advanced instincts. Both male and female care for the young ones, and Mr. Adam has seen the pair jointly hunting for a strayed one by scent and carefully convoying it home when found. Moreover, a young pair stayed about his premises in a semi-domesticated condition for more than a year, recognising strangers with squeaks, but answering to names with those they knew, while the female would even let puppies play with and pull her about.

Woad as a Crop Plant

PLANTS and animals when taken under man's care have to face natural selection in a new and special form, the struggle now being to retain his favour against competitors in cultivation and against his inventions. That highly historical dye-plant, woad, has at last succumbed in this conflict, according to an

article by Mr. A. W. Exell in the *Gardeners' Chronicle* for June 18, p. 403. Last grown in France in 1887, its cultivation in Germany had ceased about twenty years before this date, but was continued in England, in spite of the competition first of natural and then of synthetic indigo, for many years later, the product being used in the dyeing of police and naval uniforms. The industry had, however, long been a declining one, and in 1930 only two farms, both in Lincolnshire, were growing woad. Of these, one ceased to do so last year, but the other raised a small crop; this year none at all has been grown, and Mr. Exell thinks the day of woad as a crop-plant is over, though some stock of the prepared product is still left. Woad was an expensive crop to raise, and the labour and land devoted to it have been diverted to the production of potatoes and sugar-beet.

William Morgan

MR. PALIN ELDERTON in a recent lecture to the Faculty of Actuaries (*Trans. Fac. Act.*, **14**, 1932, pp. 1-20) gave an interesting sketch of the life of his distinguished predecessor William Morgan, who became assistant actuary of the Equitable in 1774, actuary a year later, and retired so long after as 1830. Morgan, who was a self-taught mathematician, owed his appointment to the famous Dr. Richard Price, whose biography he wrote (not, according to Mr. Elderton, very well), and although some of his mathematical work in connexion with joint survivorships might not have commended itself to better trained mathematicians, it was, writes Mr. Elderton, "the first serious attempt to obtain a general solution to the problems of survivorship, and had the merit—a great one indeed—of giving expressions that could be used to obtain arithmetical results from any mortality table".

Pharmacy in Scotland

THE forthcoming British Pharmaceutical Conference at Aberdeen on Sept. 12-16 has been the chief influence in the choice of material for the handsome special issue of the *Chemist and Druggist* for June 25. The majority of space has been devoted to various phases of Scottish activity from the point of view of pharmacy. An interesting account of the early history of pharmacy and the apothecary in Scotland is given by Dr. Thomas Ferguson. The cod-liver oil industry of Aberdeen and the extraction of the oil in Newfoundland are described, with useful illustrations. The appreciation of Aberdeen, the host city for the 1932 Conference, is well worth reading, and the illustrations (in photogravure) of its streets, industries, and colleges are very striking. Among the more descriptive articles is an illustrated account of the British Drug Houses, Ltd.

Announcements

THE following Royal Society research appointments are announced: Mr. C. N. Hinshelwood, Trinity College, Oxford, and Dr. M. L. E. Oliphant, Trinity College, Cambridge, to be Messel Research Fellows. Dr. W. Hume-Rothery, Magdalen College, Oxford, and Dr. A. J. Bradley, University of Manchester, to be Warren Research Fellows.

THE fourth Victor Horsley Memorial Lecture of the British Medical Association will be delivered by Prof. E. D. Adrian, on "The Visceral Sense Organs", at University College Hospital Medical School, Gower Street, London, W.C.1, on July 20, at 5 P.M. Admission to the lecture is free on presentation of a visiting card.

IN connexion with the centenary meeting of the British Medical Association at London, the popular lecture will be delivered by Prof. Julian Huxley in the Great Hall, University College, Gower Street, W.C.1, on July 29. The subject of the lecture will be "The Biology of Human Nature". Tickets can be obtained from the Organising Secretary, British Medical Association Centenary Offices, Tavistock House (North), London, W.C.1.

THE first Hinchley Memorial Lecture of the Institution of Chemical Engineers will be delivered on Oct. 28 by Mr. H. T. Tizard, Rector of the Imperial College of Science and Technology, on "Chemical Engineering and the Aircraft Industry". These lectures have been inaugurated to commemorate the long and intimate association of the late Prof. J. W. Hinchley with the Institution, and will be delivered at intervals of three years.

AN International Conference on Social Work is to be held at Frankfort-on-Main on July 10-14. The main theme of the conference will be "The Family". The work of the Conference will be divided among six commissions dealing with health services, educational influences, economic insecurity, and other subjects. Arrangements for British delegates have, at the request of the British National Committee, been undertaken by the Institute of Sociology. Particulars can be obtained from Miss E. W. Spear, Secretary, Institute of Sociology, Le Play House, 65 Belgrave Road, Westminster, S.W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A head of the Department of Mathematics and Physics at the Polytechnic, Regent Street, W.1—The Director of Education, The Polytechnic, Regent Street, W.1 (July 11). A head of the Chemistry Department at Sunderland Technical College—Chief Education Officer, Education Offices, 15 John Street, Sunderland (July 11). A chemist in the Department of Government Chemist—The Government Chemist, Clement's Inn Passage, Strand, W.C.2 (July 16). A poultry pathologist in the Department of Agriculture and Horticulture at the University of Bristol—The Agricultural Officer, The University, Bristol (July 16). A biologist for the biological survey of the Hampshire Avon—The Registrar, University College, Southampton (July 16). A lecturer in chemical engineering in the Department of Chemical Engineering at the Imperial College of Science and Technology—The Registrar, Imperial College of Science and Technology, London, S.W.7 (Sept. 9).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

New Evidence for the Neutron

SEVERAL important communications dealing with the properties of rays emitted by atomic nuclei when bombarded with α-particles have recently appeared,[1] on which we should like to make a few comments.

It has been shown by F. Joliot [2] that the rays emitted by boron under the action of α-particles from polonium are much more penetrating than had originally been indicated. Their penetrating power, while superior to that of the most powerful γ-rays obtained from radio-active sources, is inferior to that of the rays obtained from beryllium bombarded by α-particles from polonium. This result does not agree with Webster's findings, but agrees with the fact that the protons ejected from boron are slower than those ejected from beryllium. Secondly, we have shown that the ejection of protons is a general phenomenon. By means of the Wilson chamber, we have photographed the paths of the helium nuclei ejected by beryllium rays, and from absorption measurements were able to conclude that other atoms are also ejected. Further, our experiments showed for the first time the important part played by the nuclei in the absorption of the rays emitted by beryllium under the influence of α-particles, a phenomenon which clearly marked them off from all previously known radiation.

J. Chadwick was led simultaneously to the same generalisation concerning the ejection of nuclei, and he put forward the view that the penetrating rays produced by the bombardment of beryllium by α-particles from polonium are neutrons. This interpretation is necessary if energy and momentum are conserved in the collision.

Recent experiments which we have carried out with M. Savel clearly show that the rays emitted by lithium have a penetrating power, in lead, less than that of the γ-rays of polonium (they are completely absorbed by 5 mm. of lead), and that they are much more readily absorbed, at equal surface mass, by paraffin than by lead. This proves that they cannot be of an electronic or electromagnetic nature. Since for various reasons it is extremely improbable that we are dealing with hydrogen nuclei or α-particles (the energy of which would be enormous), these results prove—*independently of the ejection of nuclei and the laws of elastic collisions*—that the rays emitted by lithium under bombardment by α-particles from polonium are different from previously known radiation and are probably neutrons. The above reasoning does not apply to the rays ejected from beryllium, boron, or to those emitted by lithium when bombarded with the α-rays from the active residue of radium,[3] because in such cases we do not have γ-rays of equivalent penetrating power, for comparison.

Our latest experiments, in collaboration with M. Savel, indicate that the protons ejected from beryllium form two groups. This suggests that there are also two groups of neutrons (each group not necessarily homogeneous); one group has a range of 28 cm. in air, and an energy of $4 \cdot 5 \times 10^6$ electron volts; the other has a range of about 70 cm. and an energy of approximately $7 \cdot 8 \times 10^6$ electron volts. We find it difficult to reconcile Chadwick's result of a *maximum range* of 40 cm. with the curves which we have obtained for the absorption of protons.

The mass of the neutron calculated by Chadwick [4] (based upon the experimentally estimated energy of the neutrons from boron), according to the reaction $B^{11} + \alpha = N^{14} + n$,[5] is about 1·006 (He = 4), and the atomic mass of Be^9, based on the energy of the fast neutrons ($7 \cdot 8 \times 10^6$ ev.), is 9·006. This suggests that the binding energy between the two α-particles and the neutron in the Be^9 nucleus is relatively weak. Further, we know that the rays emitted by beryllium are composed of neutrons and photons, and we may therefore suppose that they are emitted simultaneously according to the equation

$$Be^9 + \alpha = C^{12} + n + h\nu.$$

The photons of 2 to $4 \cdot 5 \times 10^6$ ev. energy, which we have detected, would correspond to the group of neutrons of maximum energy $4 \cdot 5 \times 10^6$ ev. (protons having a range of 28 cm.).

IRÈNE CURIE.
F. JOLIOT.

Institut du Radium,
Laboratoire Curie,
1, Rue Pierre-Curie, Paris (5e),
June 25.

[1] H. C. Webster, J. Chadwick, N. Feather, P. I. Dee, *Proc. Roy. Soc.*, A, **136**, 428, 692, 708, and 727; 1932.
[2] F. Joliot, *C.R. Ac. Sci.*, **193**, 1415; 1931.
[3] M. de Broglie and L. Leprince-Ringuet, *C.R. Ac. Sci.*, **194**, 1616; 1932.
[4] J. Chadwick, *Proc. Roy. Soc.*, A, **136**, 702; 1932.
[5] I. Curie and F. Joliot, *C.R. Ac. Sci.*, **194**, 1229; 1932.

Concentration of Slow Neutrons in the Atmosphere

RECENT evidence [1, 2] of neutral particles of atomic mass and great penetrating power suggests the possibility that terrestial matter may contain similar particles of low (thermal) energies, undetected hitherto by reason of their small interaction with matter. While it has been argued that neutrons of mass 1 would rapidly escape from the earth, one would hesitate to deny the possible existence of similar bodies of greater mass, and it seems pertinent to remark that experimental evidence already exists which, if we knew the laws of collision of neutrons with matter, would at once fix an upper limit to their concentration in the atmosphere.

Consider a gravitation experiment of the Michell-Cavendish type and suppose the large attracting masses to be heated above room temperature. If the atmosphere contains a constituent enjoying relatively free passage between the 'attracting' and the 'suspended' masses, but, nevertheless, capable of some slight exchange of momentum with them, a radiometer repulsion should be experienced by the suspended masses. The arrangement constitutes, in fact, a radiometer pressure-gauge. Let m be the mass of a neutron, M, M' those of atoms of the 'attracting' and the 'suspended' bodies respectively, T' the temperature of the attracting bodies, and T that of the remainder of the system. Let us suppose that $m \ll M$ and $\ll M'$ and that the scattering of the neutrons by the atoms is elastic and nearly isotropic.[3] The law of scattering is then that for the elastic collision of a light with a heavy sphere, and it becomes possible to calculate the average rate at which momentum is exchanged between the two atoms, provided that the free path of the neutron is so great that multiple scattering in any one of the bodies is negligible. If the collision cross-sections for a neutron with the atoms in question are a, a', the average force on the atom M' due to the excess temperature of the atom M is found to be approximately

$$\frac{2paa'}{\pi^2 r^2}\left(\sqrt{1+\frac{8}{3}\frac{m}{M}\left(\frac{T'}{T}-1\right)}-1\right) \text{ dynes,}$$

r being the distance between the two atoms and p

(dynes . cm.$^{-2}$) being the 'partial pressure' of neutrons in the atmosphere. The presence of neutrons should thus entail an apparent decrease of the Newtonian gravitational constant with rise of temperature. The experiments of Shaw[4] (who found a small increase of gravitation with temperature) show that, if M refer to lead and M' to silver, a negative temperature-coefficient of more than 5×10^{-5} per °C. is improbable. If for illustration we put $m/M = 1/200$, $a = a' = 10^{-25}$ cm.^{2}, we find that $p < 5 \times 10^{-6}$ of an atmosphere. The correct cross-sections for slow neutrons are not yet known.

P. B. MOON.

Imperial College of Science,
South Kensington, London, S.W.7,
June 20.

[1] Chadwick, NATURE, **129**, 312, Feb. 27, 1932.
[2] Chadwick, *Proc. Roy. Soc.*, A, **136**, 692, 1932, and following papers.
[3] Cf. §5 of (2).
[4] Shaw, *Phil. Trans.*, A, **216**, 349; 1916.

Currents produced by the Gills of Mayfly Nymphs

BABAK and Foustka[1] were able to show that the movements of the gills of ephemerid nymphs were dependent on the oxygen tension of the water. Later, Dodds and Hisaw[2] demonstrated a relation between the gill area per gram weight of the animal and the oxygen tension of the water inhabited by these animals. That the currents produced by the gills might differ in different species, and that such currents might have an adaptive significance, appear to have escaped notice.

The following five species from stagnant and running waters are being examined: *Chlœon dipterum* and *Leptophlebia marginata* as examples of pelagic animals in stagnant water; *Ephemera vulgata*, a form burrowing in fine mud or sand in running water; *Ecdyonurus venosus*, associated with fast streams with stony beds; and *Cœnis horaria*, a form which burrows in fine mud to such a small depth that the gills are left exposed in the water at the mud surface.

In each case the gills move in metachronial rhythm, and problems comparable with those elucidated by Cannon and Manton[3, 4] on the feeding mechanisms of Crustacea are presented.

The erect plate-like gills of *Chlœon* moving in metachronial rhythm create differences of pressure in the intergill spaces. Thus in any intergill space a period of suction is followed by a period of compression. The main result of this is a symmetrical current passing backwards over the abdomen and outwards in an upward direction between the gills. The last gills are stationary and act as buffers, directing the current strongly to each side. This prevents the setting up of eddies near the animal in that region and ensures that the same water will not be used again for respiration.

In *Leptophlebia* it is not yet clear how far pressures set up between the gills are significant, since the gills lie at different angles to the body. The gills act as paddles, and by their rotation throw water over themselves from in front, or the sides of, or from beneath the body to the middle dorsal line. Since the gills are moving at different levels of the water opposite the several segments of the abdomen, water from all regions round the body is explored for respiratory purposes.

Ephemera in its mud tunnel creates a simple posteriorly directed current over the dorsal side of the abdomen. The gills are held upwards over the back in a roof-like manner. Moving in metachronial rhythm from before backwards, they press backwards the column of water beneath them and thereby set up a rapid current very appropriate for a creature with such burrowing habits.

The gills of *Ecdyonurus* project postero-laterally from the body. Lying in the angles between the broad hind femora and the abdomen these gills are protected from the rapid flow of water in which the animal lives. There is little difference of phase in the metachronial movement of the gills. The current produced passes from the outer sides of the body upwards between the gill plates to the mid-dorsal line. The animal commonly faces upstream, and the environmental flow of water thus assists in the removal of the 'gill current' along the animal's dorsal side to the posterior region.

Cœnis possesses a pair of elytroid protective gills. These are held upwards at an angle of about 40°, while the remaining four pairs of gills, behind and beneath

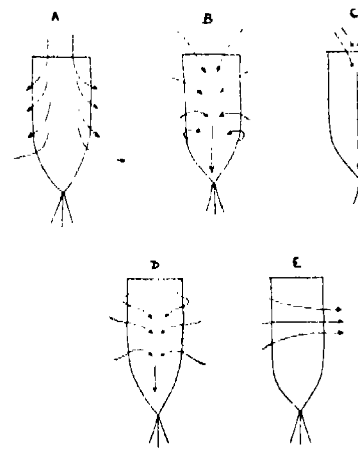


FIG. 1.—Diagrams of currents over the abdomen in A, *Chlœon dipterum*; B, *Leptophlebia marginata*; C, *Ephemera vulgata*; D, *Ecdyonurus venosus*; and E, *Cœnis horaria*.

them, beat in metachronial rhythm. In this form, as opposed to all the others mentioned, the current is asymmetrical. It flows in between the moving gills, beneath the 'elytra' at one side and out at the other. To this fact may be related a remaining one. Whereas, in the first-mentioned species, members of a pair of gills beat simultaneously, here the members of a pair of gills in motion are out of phase with each other. Thus, in addition to a metachronial rhythm along the animal, there is a similar rhythm from side to side in two elements of a pair.

The details of the above phenomena are being investigated with the aid of the stroboscope.

L. EASTHAM.

Department of Zoology, University,
Sheffield.

[1] Babak, E., und Foustka, O., *Arch. Ges. Phys.*, **119**; 1907.
[2] Dodds, G. S., and Hisaw, F. L., *Ecology*, **5**; 1924.
[3] Cannon, H. G., *Trans. Roy. Soc., Edin.*, **55**; 1927 and 1928.
[4] Cannon, H. G., and Manton, S. M., *Trans. Roy. Soc., Edin.*, **55**; 1927.

Discontinuous Distribution in Bees

IN 1898, I described a new genus of bees, *Hesperapis*, based on a species found in New Mexico. Since that time, sixteen other species have been referred to this genus, which proves to be especially characteristic of the south-western deserts, in California, Lower California, and adjacent regions. In 1911, Friese described a genus, *Capicola*, from the deserts of South Africa.

Last year's African Expedition led to the discovery of no less than seven new species in South Africa, the localities being Graaff-Reinet, Calvinia, Nieuwoudtville,

and Van Rhyn's Pass. One of these species, collected by Miss Alice Mackie, I have named *Capicola aliceæ*. The female has the clypeus with a median sulcus; hind tibiæ and tarsi red; spur of mid tibia with about thirteen oblique closely set fine spines; hair at apex of abdomen black. The male has the hind tarsi reddish; hair at apex of abdomen not black; sixth sternite light red, strongly bilobed. The species comes from Calvinia and Nieuwoudtville. It was when describing this species that I was struck by the extraordinary resemblance to the American *Hesperapis*. On making comparisons, I failed to find any generic character to separate *Hesperapis* from *Capicola*. This was so extraordinary that I sent a pair of *C. aliceæ* to Mr. P. H. Timberlake, of California, who has a much larger collection of *Hesperapis* than anyone else. He made a minute study, including the genitalia, and now reports (May 12):

"My conclusion is that *Capicola* is exactly the same as *Hesperapis*, and the distribution is of course very extraordinary. Perhaps the genus is a very ancient one, formerly wide spread, but has mostly died out, except under desert conditions. If that is so, why does it not occur in the desert regions of Asia? I dissected *C. aliceæ* and found good specific differences to distinguish it from the California and New Mexico species, but certainly nothing generic. All our North American species that I have examined have the genitalia extraordinarily alike, these parts being in fact rather poor for the differentiation of species. *C. aliceæ* has the genitalia of the same type, and in fact there is not a great deal of difference in the ædeagus itself. The eighth ventrite is somewhat more specialised in the South African insect, and the seventh still more so."

Thus *C. aliceæ* must become *Hesperapis aliceæ*. I cite these details in order to show that apparently these insects are truly congeneric, and the resemblances are not due to convergence.

We are reminded of the distribution of the tsetse flies (*Glossina*), which at present live in Africa (we had the pleasure of collecting both *G. palpalis* and *G. morsitans* in the vicinity of Bukama), but in Miocene times were represented by several species in Colorado.

These facts, and others like them, serve to show the enormous antiquity of many insect genera, and at the same time their liability to be exterminated over large areas.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado,
May 16.

A Hermaphrodite Sea-Urchin

COMPARATIVELY few cases of hermaphroditism have been recorded among echinoids. Gadd [1] has described a specimen of *Strongylocentrotus drœbachiensis* with four segments of the gonad female and one segment male. Gray [2] has described a specimen of *S. lividus* with three segments female and two mixed female and male. He has also described [2] a specimen of *Arbacia pustulosa* which was apparently a castrated male with some secondary female characters.

A specimen of *Echinus esculenteus*, taken in twenty fathoms on the 'Breast' ground, off Port Erin, in April, had four segments of the gonad female and one male. These were all typical in colour—translucent yellowish in the female and ivory-white in the male. In volume and condition also they were typical for the locality, though less full than from inshore specimens. Two of the female segments were joined, but the rest were discrete. These two segments and the one opposite to them were ripe and had full vesicles. The fourth female segment was less full and only about three-quarters ripe. The male segment was ripe and had full vesicles, but was smaller in volume than the ripe female segments. A self-fertilisation yielding normal plutei was obtained. This is the only hermaphrodite which has been found among about three thousand urchins opened in the past year.

HILARY B. MOORE.

Marine Biological Station,
Port Erin, I.O.M., May 23.

[1] *Zool. Anz.*, **31**, 635; 1906.
[2] *Proc. Camb. Phil. Soc.*, **20**, 481; 1921.

Rectilinear Propagation and Diffraction of Electrons

DURING the preliminary adjustment of an electron diffraction apparatus for use with organic vapours, some interesting phenomena were observed.

Fig. 1 is a diagram of the camera; *AB* is 15·8 cm., *BC* is 14.4 cm., and *CP* is 43·8 cm. *A* is a plane,

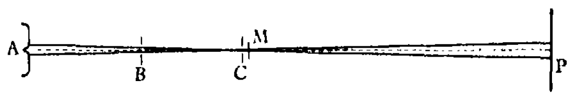


FIG. 1.

highly polished cathode of electron metal (magnesium alloy). *B* and *C* are two circular holes 0·3 mm. and 0·15 mm. in diameter respectively. *M* is a piece of mica showing thin film colours of the first order. *P* is a photographic plate. The space between *C* and *P* was evacuated to 10^{-5} mm. and was only connected to the discharge space ($A - B$) through the holes *B* and *C*. The centres of *A* and *B* and *C* were accurately aligned along the axis of the apparatus, and the plane of *A* was at right angles to same.

After adjusting the discharge so as to obtain a clearly defined cathode beam, using air as the medium, a brilliant diffraction pattern was visible on a fluorescent screen placed at *P*. On enlarging the pattern,

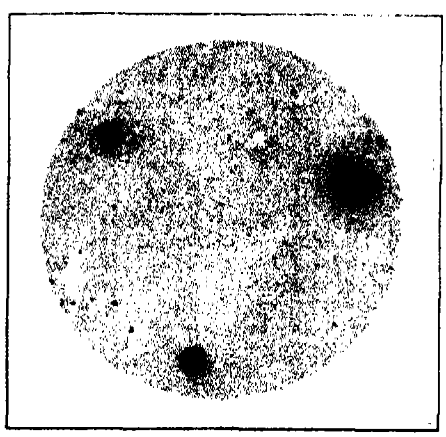


FIG. 2.

the spots were found to consist of a circle with a bright spot at the centre. Fig. 2 shows three of these spots (×3). In the case of this photograph, the diameter of the rings was 0·45 mm. and of the centre spot 0·06 mm., using electrons of wave-length 0·07 A. The small size of the central spots enables very accurate measurements of length to be made between them.

A monochromatic beam of electrons was assured by keeping the high voltage ripple below one-tenth of 1 per cent and the discharge conditions constant. This resulted in clearly resolved diffraction images.

With no mica in the path of the beam, a similar spot with a bright centre was obtained and could be observed directly on the screen through a microscope. On starting the discharge with a fresh cathode, only a single spot of about 0·5 mm. diameter is seen, diminishing in intensity towards the edge. After a few minutes a ring forms, and gradually increases in diameter with the formation of a centre. The centre brightens until the comparatively stable condition shown in Fig. 2 is attained at the end of about an hour of discharge.

These variations in the spot seem to show that we have here a pin-hole picture of the emitting surface of the cathode. The central spot only forms after a minute crater has appeared on the cathode through positive ion bombardment. This crater grows and with it the intensity of the spot. On examining the geometry of the system, we see that hole *B* plays but a small part, and that *C* acts as pin-hole lens for reproducing the cathode on *D*. This shows that electron beams obey the simple laws of geometrical optics. Campbell Swinton [1] suggested that cathode beams are hollow, with a central pencil down the axis for soft discharge, but did not observe this phenomenon in hard tubes.

If the distances between the diffraction images in Fig. 2 be measured, we find that the triangles formed by the images are nearly isoceles and definitely not equilateral (see Kikuchi [2]). Accurate measurements on various micas are being made.

By using beryllium as a cathode we hope to achieve more constant conditions than with electron metal. After a few hours of discharge the centred ring is formed and should remain fairly constant for a long time. On inserting fused quartz or mica diaphragms in front of the cathode with a hole about 0·2 mm. in diameter, we hope to eliminate the circle and thus obtain the very fine central pencil by itself.

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[1] *Proc. Roy. Soc.*, **61**, 79; 1897.
[2] *Jap. J. Phys.*, **5**, 87; 1928.

Influence of Light on Paramagnetic Susceptibility

BOSE and Raha have reported [1] that they had observed a diminution of the susceptibility of a chromic chloride solution and of other coloured paramagnetic solutions, when the solutions were exposed to concentrated visible light. They interpreted their result as due to the fact that, by the absorption of light, some of the metallic ions are transferred into excited states, in which they would have a lower magnetic moment than in the basic state. This would indicate that in the case of chromic chloride, one of the three electronic spins had been reversed, with respect to the other spins, in the transition.

Specchia [2] tried to repeat these observations by the capillary ascension method, but came to no definite results. My own preliminary observations, with the aid of a long-periodic torsion balance, confirmed Bose and Raha's observations.

It occurred to me [3] that the explanation given by Bose and Raha would necessitate an extraordinary long life of the ions in the excited states, which had to be at least of the order of 0·1 second. Moreover, the energy which is absorbed will in the end for the greater part be transformed into heat, and the resulting rise of temperature of the substance will, according to Curie's law, also cause a decrease of the susceptibility. One can calculate the influence of this temperature effect for the extreme case when the excited ions have no magnetic moment at all during a time T, if we suppose that the absorbed light of a wave-length of 6000 A. is transformed into heat after the same time T. It appears that for a saturated solution of chromic chloride, in a time so short as 4·5 T, the influence of the temperature effect will already be equal to the effect due to the presence of the excited atoms.

The result of this calculation suggests that the observed change of the susceptibility is entirely due to the rise in temperature.

I have tested this latter hypothesis in the following way: Two equal bulbs, filled with a saturated solution of chromic chloride, were suspended by a torsion wire symmetrically in an inhomogeneous magnetic field, so that the magnetic forces exerted on the bulbs were in equilibrium. The periods of the torsion balances used were rather short: 15 and 30 seconds.

When the light of a high-pressure mercury arc was concentrated on one of the bulbs, a change in the susceptibility could be observed, which increased with the time, and could be interpreted, assuming Curie's law, as due to a rise in temperature of 0·0010° per second. The red and infra-red rays were filtered off by a solution of cupric chloride, and as the arc was calibrated with a flicker photometer, it could be estimated that the energy of the visible light falling on the bulb was sufficient to cause a rise of temperature of about 0·0013° per second. Afterwards the rise of temperature was measured directly in the same arrangement with a thermo-element and proved to be 0·0011° per second, the rise being linear with regard to time during the experiment.

The agreement with the measurements on the change of the susceptibility is satisfactory, and it may be concluded that the effect observed by Bose and Raha really exists, but is very probably due to a rise of the temperature of the substance. No conclusions about magnetic moments in excited states can thus be drawn from such experiments.

I wish to express my thanks to Prof. A. D. Fokker and to Dr. A. C. S. van Heel for the active interest they showed in this research, and to Prof. W. J. de Haas, who kindly put the mercury arc at my disposition.

C. J. GORTER.

Natuurk. Laboratorium van
Teylers Stichting,
Haarlem, May 23.

[1] NATURE, **127**, 520, April 4, 1931.
[2] O. Specchia, *Il Nuovo Cimento*, **8**, 179, 291; 1931.
[3] C. J. Gorter, *Arch. du Musée Teyler*, **37**, 182; 1932.

Infra-Red Bands in the Aurora

IN his letter in these columns [1] regarding the infra-red aurora spectrum observed by Vegard, Jevons failed to say anything about an intensity phenomenon in the first positive bands of nitrogen to which I first directed attention in a note in the *Physical Review*. [2] I called this phenomenon the variation of intensity within a progression, the progression in this case being a 'v'' progression. It is strikingly demonstrated in Lord Rayleigh's [3] experiments on the afterglow in mixtures of nitrogen and the rare gases. In this paper Lord Rayleigh suggested that the auroral radiation of wave-length 6323 A. was probably the first positive nitrogen band (10, 7). In directing attention to Lord Rayleigh's experiments, I pointed out that his results could be interpreted as either real or apparent violations of the Franck-Condon rule for band intensities. Recently, a similar result in iodine, namely, the observations of Ramsauer on the quenching of a fluorescence series in an iodine-oxygen mixture, was explained by Loomis and Fuller, [4] who

suggested that the effect was due to irregular reabsorption of the fluorescent light. The irregularity of the reabsorption was explained by enhanced predissociation in the upper electronic state. A similar explanation could apply just as well to nitrogen, since enhanced predissociation is produced in the upper electronic state of the first positive bands in the presence of rare gases. In both iodine and nitrogen the phenomenon of variation of intensity in a 'v' progression would have to be interpreted as an apparent violation of the Franck-Condon rule.

The connexion between the phenomenon which has been discussed above and the identification of the 7883 radiation in the aurora as the first positive nitrogen band (7, 6) is obvious. If (7, 6) is observed in the aurora, then why are (7, 3), (7, 4), and (7, 5) missing? According to the Franck-Condon rule, these bands should be stronger than (7, 6), and yet they have never been reported in any auroral displays. The 6323 radiation which was identified as the band (10, 7) presents a similar problem. The observation in laboratory experiments of violations of the Franck-Condon rule, be they real or apparent, enable us to identify such bands as 7883 and 6323 as nitrogen bands.

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University of California at Los Angeles,
June 6.

[1] NATURE, 129, 759, May 21, 1932.
[2] *Phys. Rev.*, 36, 778; 1930.
[3] *Proc. Roy. Soc.*, A, 102, 453; 1922.
[4] Loomis and Fuller, *Phys. Rev.*, 39, 180; 1932.

Chain Reactions in Enzymatic Catalysis

I MUST thank Dr. Richter[1] for raising the fascinating problem of whether enzymes act by initiating chain reactions. If this is correct, the value which I calculated[2] for the number of hydrogen peroxide molecules destroyed by a catalase molecule per second, namely, about 10^5, retains its biological significance, but the enzyme surface is far less active than I supposed. The view that oxidative enzymes in general initiate chain reactions was put forward by Haber and Willstätter.[3] I propose to examine this view, but only some of the arguments which I shall bring against it would be valid if catalase were unique among enzymes in starting a chain reaction. This is, however, very unlikely. Peroxidase was shown by Kuhn, Hand, and Florkin[4] to have the same degree of activity per molecule per second, and a very similar active hæmatin grouping.

The chain theory renders the proportionality observed in many cases between enzyme concentration and reaction velocity unintelligible. If the chains end when two free radicals meet, as Haber and Willstätter assume, their length should be shorter the greater the concentration of radicals, and the reaction velocity should be about proportional to the square root of the enzyme concentration, as Allmand and Style[5] found it proportional to the square root of the illumination when hydrogen peroxide was photolysed. If the chains end on the walls or other foreign substances, the velocity should be appreciably reduced by some of the very miscellaneous impurities found in catalase preparations. Zeile and Hellström,[6] among others, found that neither of these conditions was fulfilled in the case of catalase.

Again, the chain theory does not account for specificity. Thus Haber and Willstätter postulate free OH radicals not only in the catalase reaction, but also in the actions of acetaldehyde oxidase and alcohol oxidase. If this were the case, catalase would catalyse the oxidation of acetaldehyde and alcohol by hydrogen peroxide. Similarly, they postulate meriquinoid radicals as links in the chain produced when a dehydrogenase catalyses the reduction of a quinone by a hydrogen donator such as succinic acid. If this were so, dehydrogenases would not be specific, for a meriquinoid radical produced by the dehydrogenation of succinic acid could proceed to remove a hydrogen atom from a different hydrogen donator, for example, glucose or lactic acid.

Finally, the theory does not explain the fundamental fact that most intracellular oxidations do not yield heat directly, but the energy of oxidation is mainly transferred to other molecules. For example, the energy of oxidation in muscle is largely used to resynthesise glycogen from lactic acid. These coupled reactions, involving as they do the interaction of at least four molecules, can only occur at a specific surface where the various reactants are held simultaneously. It is extremely difficult to see how such a reaction could occur in a homogeneous medium, especially when the molecular concentrations of some of the reactants are very low. For example, the oxygen concentration in tissues is less than 10^{-4} M, and it can fall below 10^{-7} M without slowing down bacterial respiration.

For the above and other reasons, I think that the majority of biochemists will demand very strong experimental evidence before they accept the chain theory of enzyme action.

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[1] NATURE, 129, 870, June 11, 1932.
[2] *Proc. Roy. Soc.*, B, 108, 559; 1931.
[3] *Ber.*, 64, 2844; 1931.
[4] *Z. physiol. Chem.*, 201, 255; 1931.
[5] *J.C.S.*, 606; 1930.
[6] *Z. physiol. Chem.*, 192, 171; 1930.

Occurrence of *Bathynella* in England

IN 1927 I happened to visit the well-known Bath Stone Quarries at Corsham, near Bath, for the purpose of collecting *Cyclops* from the underground water of the district.

Looking through the material on my return to Marlborough, I came across two specimens of a small crustacean that I was unable to identify and they were put on one side, as I was working at the time exclusively on the distribution of *Cyclops* and hydrogen ion concentration.

In 1931, quite by accident, I again examined these two specimens, and found them to belong to the very remarkable group, the Syncarida. Both specimens were immature and not well preserved, but they were evidently *Bathynella* or *Parabathynella* and were sent to Dr. W. T. Calman, keeper of zoology at the British Museum (Natural History), who identified them provisionally as *Bathynella chappuisi*, Delachaux.

The Bath Stone Quarries are very extensive, comprising some sixty miles of trolley lines and containing a number of underground wells. In addition, one has to work entirely in the dark except for an electric torch, since the galleries are about 100 feet below the surface, and it seemed as if the rediscovery of these minute animals might be a very long task.

On June 15 of the present year I came across twenty to thirty living specimens and there is reasonable evidence that the piece of water in which they occurred is a remarkably permanent one, so that now, knowing the exact spot, one can go there with a reasonable amount of confidence.

Dr. Calman and Dr. Isabella Gordon have now examined some fresh specimens and are apparently satisfied that the original diagnosis was correct. The species is therefore *Bathynella chappuisi*, Delachaux.

Since no member of the Syncarida has been recorded from the British Isles before, the occurrence of these animals is of more than ordinary interest.

A. G. Lowndes.

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Mr. Lowndes is to be congratulated on a discovery of exceptional interest. Since *Bathynella* has scarcely yet penetrated into English textbooks of zoology, it may not be superfluous to give a brief summary of its history.

Just half a century ago, Prof. Vejdovsky found in a well in Prague two examples of a minute crustacean which he was unable to refer to any of the recognised groups. Eighteen years later he kindly allowed me to re-examine the surviving type specimen and I was able to point out its resemblances to the Tasmanian *Anaspides*. Another fifteen years had to elapse, however, before the animal was found again, this time in Switzerland by Dr. P. A. Chappuis. A second species was later described from Switzerland by Dr. Th. Delachaux, and has also been recorded from Rumania. It is to this second species that Mr. Lowndes's specimens appear to belong. Since then a related genus, *Parabathynella*, has been described by Chappuis from Serbia, and the gap separating the European Syncarida from their Australian and Tasmanian relatives has been partly bridged by Sars's unexpected discovery of another species referred to *Parabathynella*, from a cave in the Malay Peninsula.

These minute, blind, subterranean crustacea are the degenerate survivors of the Syncarida found as fossils in the Carboniferous rocks of Europe and America, which have disappeared from the surface of the earth, except in Tasmania and Victoria.

No doubt careful search in the subterranean waters of wells and caves would greatly extend the known range of these crustacea, and it is to be hoped that Mr. Lowndes's example will lead cave explorers to turn their attention to the almost unknown cavernicolous fauna in the British Isles.

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June 24.

River Gauging and Flood Prevention

It is with great satisfaction that I have read the leading article on this subject in Nature of July 2 with its complimentary reference to my measurements on the Ness Basin. On this area there are six principal water-level stations at which continuous records are being kept on clock-driven gauges. The measurements of flow, at ordinary flood and low water stages, of the three principal rivers are completed, and all that is now necessary is the maintenance, for all time, of the water-level records—a continuity that no individual can assure. The Caledonian Canal has kept daily water-level records over a great number of years and it is now possible to give with considerable accuracy the flow from Loch Ness during the great floods of the past. If the big water interests of the area will combine to assure the maintenance of my established water-level stations, and to establish other stations when required, there is no problem connected with the use of their water resources which cannot be tackled satisfactorily.

There is no doubt that inland water survey should become a national matter and that it demands a water survey department, such as forms part of the Geological Survey of the United States, which publishes hundreds of papers on systematic investigations of surface water supply.

Local associations or bodies representing the water interests of the areas should be formed to carry out the water-level work and to keep the records. The superintendent of the local association should be under the authority of the national water survey department.

In the article in Nature it is suggested that the new Drainage (or Catchment) Boards should carry out all this survey work; and I agree, provided the water survey work is definitely under the control of a water survey department of the Ministry of Agriculture, because it is necessary to assure that the many arduous duties which will devolve on these Boards will not deflect the course of systematic measurement.

Existing water users have already a mass of useful data; and as these users are invaluable collectors of data, they should be represented in any water survey organisation. This is effected in the United States through the central control of the Geological Survey.

The lead given in Nature should be most helpful in bringing us one step nearer to the much-needed organisation of a water survey of Great Britain. The subject is to be discussed at a joint meeting of Sections A and E at the forthcoming York meeting of the British Association; and it is to be hoped that the result will be the formation of a national body to carry out the survey required.

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Scientific Method

The subject of the leading article of Nature of May 28 must commend itself to the earnest consideration of all those who view with consternation the present drift of our civilisation towards chaos. Nothing is more needful than what, for want of a better word, we call the 'scientific' point of view. Nevertheless, experience has shown that the great investigator is seldom well fitted to guide the course of practical affairs; the 'passion for discovery' differs little from other passions in being linked with a certain prejudicial obstinacy. On the other hand, the exposition of the rules and principles of scientific method can be made intelligible only when the intellect has been already hardened by the educational disciplines inseparable from a system the prizes of which are awarded to those with most 'knowledge'—often synonymous with good memory.

There is, I submit, a middle course, namely, in the teaching of the history of scientific ideas. I say, "scientific ideas", since the usual hotch-potch of names and dates is scarcely history and certainly not science. But in the scholarly and critical exposition of such works as Newton's "Opticks", Harvey's "Disquisition", and Boyle's "Sceptical Chymist", in their true historical setting (in the absence of which they appear merely as 'out of date'), illustrated by such experimental methods as were available to these great thinkers, we may show science as a living, growing organism, born of intellectual *struggle*; we may teach the little known truth that theories which have been 'proved' to be 'wrong' have often only been shown to be inadequate.

By some such means we may, I believe, inculcate a just appreciation of the *real* meaning of fact and hypothesis, of cause and law. Incidentally we may both learn and teach caution and modesty, two qualities that do not always characterise the pronouncements of modern science.

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Research Items

Mortuary Caves of Szechwan, China.—Relics from the artificial caves of Szechwan Province in western China have been described by the collector, Mr. David C. Graham (*Proc. U.S. Nat. Mus.*, Art. 16, vol. 80). Thousands of these artificial caves are to be found in the sides of the hills and cliffs from Hupeh Province on the east to the highlands of the Szechwan-Tibetan border and along the Yellow River in the province of Kansu. Varying from a few feet to 130 ft. in depth and about six feet high by six feet wide, they are carved from the solid stone, the sides plainly showing chisel marks. Some are so close to one another that holes have been knocked in the dividing walls. It is popularly believed that they are 'barbarian'; but on both historical and archæological grounds it is demonstrable that they do not antedate the Chinese and almost certainly belong to the Han dynasty at about the beginning of the Christian era. The best caves have elaborate carvings above and around the front openings and on the sides and pillars near the entrance. Certain conventional designs in these carvings are also found on Han monuments of various types. A large number of burnt clay figures have been collected from the caves. Glazed figures are rare, but a fragment of a bottle-neck and part of a pottery bell show a green glaze. The figures include the foot of an elephant, dogs, fowls, horses' heads, human figures—among these, servants, actors, a figure playing a flute, etc., in costumes which indicate that little change has taken place in dress down to the present day. The clay vessels show the use of the potter's wheel. The commonest artefact is the earthenware coffin. Many carvings and artefacts reflect customs or represent implements in present use among the Chinese, but not among any primitive tribes.

Archæology of Eastern Colorado.—The second report by Dr. R. B. Renaud, director, on the work of the Archæological Survey of Colorado (published by the Department of Anthropology, University of Denver) describes the field-work carried out during the summer of 1931. It covered the valley of the Upper Arkansas in southern Colorado and the valley of the South Plate River and the territory north of it in the northern part of the State. The ground has now been cleared for preparing a better contact between Colorado and Wyoming and for an approach to western Nebraska, the next field of operation. The total number of sites covered in the present report is 116, of which eleven are double, that is, pictographs are found on both sides of the river or there is a major site on one side and a minor, possibly a look-out, on the other. Camp sites were by far the most frequent, 37 being reported from the South-Platte drainage area, 19 from the Upper Arkansas, and 8 south of Denver. A great many possibly date from the prehistoric period. 19 workshops were found, of which 13 were in the north. The northern area is distinguished by its more abundant camp sites and workshops, its more frequent sites with tipi rings, as well as its more numerous metates and manos. On the other hand, the southern area comprises all the sites with pictographs and stone enclosures, as well as two of the three known rock shelters. There are evidently cultural and geographical differences between the two areas. The collection of artefacts made in 1931 was not extensive; but some large collections in private hands were examined. The same distinction between the culture of the northern and southern areas is to be noted in the distribution of the classified types of implements; while in regard to their material, in both areas that most commonly employed is quartzite, but the place of flint, which comes second in the south, in the north is taken by chalcedony.

Brachial Muscles of Primates.—In a paper on the brachial flexor muscles in primates, A. B. Howell and W. L. Strauss, jr. (*Proc. U.S. Nat. Mus.*, vol. 80, 1-31; 1931), state that these muscles as a whole exhibit no distinct phylogenetic trend; the variations are individual rather than generic. The authors direct attention to the contrasting specialisations of the biceps muscle in the Lorisinæ and the Hylobatidæ. In all other primates this muscle is normally composed of the coracoid and long heads. In the lorises (*Nycticebus*, *Loris*, and *Stenops*) the biceps possesses one head of the long variety, the coracoid head being missing. In the gibbons (Hylobatidæ) the long head is present, but the coracoid head is replaced by one arising from the humerus, and there are most intimate connexions with the surrounding muscles, for example, the pectoralis major and the forearm flexors, which produce a mechanical arrangement well adapted to the extreme mode of brachiation exhibited by the gibbons. This unique anatomical arrangement is clearly an extreme functional adaptation peculiar to the gibbon, and cannot be regarded as representing a stage in the evolution of the biceps of man and the anthropoid apes. While this structure of the gibbon's biceps seems undoubtedly to be adaptive, it is apparently not a necessary outcome of the brachiating mode of locomotion, for such able and constant brachiators as *Ateles*, *Colobus*, *Pan*, and *Pongo* exhibit no trace of such an arrangement.

Deep Sea Collecting.—For three years now the Bermuda Oceanographic Expeditions of the New York Zoological Society under the leadership of Dr. William Beebe have made collections of deep-sea animals in the same region nine and a quarter miles south south-east of Nonsuch Island, Bermuda. That these collections must be becoming very complete as representative of the deep-sea fauna in that area is shown by a recent publication (*Zoologica*, **13**, No. 3), which gives the lists of hauls made during May-November in 1931. Up to the present date, 1350 collections have been made at all depths down to 2000 fathoms in mid-water, the majority being at the surface and between 500 and 1000 fathoms. The fruitfulness of these collections is already shown by two further publications in the same periodical (**13**, Nos. 4 and 5). In the former Dr. Beebe describes nineteen new species of deep-sea fish, and in the latter the same author and John Tee-Van record six new species of shore fish from that region. It is by such continuous collecting that the sparsely distributed members of the pelagic deep-sea fauna will become better known, and we hope that more material will be accumulated; for until the many unknown forms have been fully classified and described the study of their life histories is impossible.

Nuclear Structure.—Prof. Ruggles Gates devoted his presidential address to the Royal Microscopical Society (*J. Roy. Micr. Soc.*, **52**, 1932, pp. 1-19) to a consideration of recent work on nuclear structure. Evidence is accumulating that in plant cells the nucleolus generally contains two substances which may occasionally form separate bodies, and that one of these substances enters into the prophase transformations of the chromosomes, while the other does not. He referred to observations on the chromosome vesicles or karyomeres which show that these become closely appressed in the resting condition of the

chromosomes (for example, in the teleost *Fundulus*), but the delicate vesicle-walls persist and the vesicles do not completely coalesce until after each has formed a chromosome within itself in the prophase. This and other examples afford evidence that each chromosome maintains its morphological peculiarities from one cell generation to another, and confirms the view that the resting nucleus contains the chromosome materials in the same spatial arrangement as in the preceding telophase. Interesting comments are given on the spindle fibres and on cases of polyploidy in certain somatic tissues while the germ cells in the same animals remain diploid. Prof. Gates discussed the internal structure of the chromosomes and their method of division and made reference to mitoses in cells of root tips, which show that the chromosome splitting occurs in one metaphase for the separation which is to take place in the next. In an estimate of the size of genes, Prof. Gates remarked that it would appear probable that they and virus particles are about the same order of size, each containing not more than a few hundred organic molecules, and that it seems likely particles of this size are the smallest in which vital phenomena can be exhibited.

Virus Diseases of Potatoes.—The results of the studies of plant virus diseases financed by the Empire Marketing Board are now being published. The most recent works are to be found in the *Scientific Proceedings of the Royal Dublin Society*, vol. 20 (n.s.), Nos. 15, 18, and 20, May 1932. Paper No. 15 is by Dr. Phyllis Clinch and reports the results of " Cytological Studies of Potato Plants " (pp. 143-172). The green parts of mottled leaves have a structure similar to healthy organs, whilst the yellow areas are distinctly thinner. The peculiar vacuolate inclusions known as X-bodies have been found in the chlorotic areas of leaves infected with crinkle, streak, interveinal, and simple mosaics. They were not seen in aucuba mosaic or leaf roll plants, or on healthy leaves. Their discovery seems to confirm their inclusion in the virus diseases, since the X-bodies are almost exclusively found in this group. Paper 18 is by Dr. P. A. Murphy and is entitled " A Critical Review of some Recent Work on the Occurrence of Virus Complexes in the Potato " (pp. 193-210). The author reviews the literature, which suggests that many virus diseases of the potato are not single diseases but are the results of two or more viruses acting together. Dr. Murphy considers that it would be easier to explain these phenomena by regarding the virus as a chemical substance. Paper 20 is by Dr. P. A. Murphy and Mr. R. McKay. It describes " The Compound Nature of Crinkle and its Production by Means of a Mixture of Viruses " (pp. 227-247). A virus, called 'virus A', has been found to produce symptoms of the disease known as crinkle on the variety Irish Chieftain if the latter was previously infected with simple mosaic. This finding is in accord with the work of Dr. R. N. Salaman of Cambridge, who has separated three constituent viruses from English crinkle.

Age of Monazite from Portland, Conn.—Dr. C. N. Fenner has analysed for uranium, thorium, and lead a crystal of monazite from a pegmatite occurring at Portland, Connecticut (*Amer. J. Sci.*, April 1932). The results may be summarised as follows :

$PbO = 0 \cdot 1086$ per cent	$Pb = 0 \cdot 1007$ per cent
$U_3O_8 = 0 \cdot 00$	$U = 0 \cdot 00$
$ThO_2 = 8 \cdot 52$	$Th = 7 \cdot 489$
$\frac{Pb}{0 \cdot 36 Th} = 0 \cdot 037$.	Age $= 278$ million years.

The age corresponds with the close of the Devonian. Special interest is attached to this result from the fact that the uraninite from the same quarry which was analysed by Hillebrand many years ago has a lead-ratio of $0 \cdot 038$. The check is very gratifying and gives additional support to the essential correctness and reliability of the principles on which the age of radioactive minerals are based. In particular it should be noticed that the agreement depends on the use of the value $0 \cdot 36$ for k (the factor by which Th is multiplied in the formula). With $k = 0 \cdot 25$, as recently advocated by Kirsch, there would be a considerable discrepancy. The value $0 \cdot 36$ is further supported by the concordant results obtained by Fenner from samarskite and monazite from Brazil.

A Fossil Horned Artiodactyl Ungulate from Texas.—Among the fossils recently acquired by the Palæontological Museum of the University of California through the generosity of Miss Annie M. Alexander, is the skull of a remarkable horned artiodactyl from the Pliocene of Texas. It is described by Dr. R. A. Stirton (*Bull. Dept. Geol. Univ. California*, vol. 21, No. 6, 1932), who shows that it represents an extreme development of the four-horned skull of *Protoceras* which was discovered by the late Prof. O. C. Marsh in the Oligocene of South Dakota. *Protoceras* has a pair of frontal horns and a pair of premaxillary horns of moderate size. A somewhat larger animal, *Syndyoceras*, from the Lower Miocene of Nebraska, has the same horns much elongated. The new skull from Texas, which is of still later geological age and is named *Synthetoceras*, is again larger, and has the premaxillary horns relatively enormous and fused together except at their free tips. The succession is thus interesting as showing the same increase in the relative size of the horns which is already known in successive members of other groups of artiodactyls, such as the deer.

Estimation of Ground Water.—In connexion with the important series of reports on ground water supplies in the United States, the Geological Survey of that country has published a pamphlet on " Methods of Estimating Ground-water Supplies " (*Water-Supply Paper* 638-c), which contains a full discussion of the problems involved, with references to the literature of the subject. No one method is applicable to all conditions. Some water-bearing formations function chiefly as reservoirs, others chiefly as conduits, but all of them have some of the properties of both. Some of the methods estimate the intake from surface streams by gauging stations, others estimate the discharge from springs, or the intake may be estimated from rain and melting snow and the discharge by evaporation from the soil or by the transpiration of certain selected plants grown in tanks with measured quantities of water. It would appear, however, that the most trustworthy measurements are obtained by water-stage recorders installed over wells. Water levels in wells are sensitive to every change that takes place in ground water, and these changes can be almost perfectly recorded by an automatic recorder. But all methods are being tried, and great improvements have been effected in recent years.

Spectrum of the Solar Corona.—A paper was read by M. Bernard Lyot on Feb. 19 before the Société Française de Physique, in which he gave an account of the success which has now attended his efforts to study the solar corona at the Pic du Midi at other than eclipse times (*J. Phys.*, 3, 31 S). The main new feature in his work is the great care taken to avoid parasitic light in the optical system ; the other usual source of trouble, diffraction by gross particles in the atmosphere, was not serious. The spectrum of the green line has been obtained on a grating with a dispersion of $1 \cdot 2$ A. per mm., and the red line has been photographed with a prism giving 11 A. per

mm.; the average wave-lengths for these are given as 5302·83 ± 0·03 A. and 6374·75 ± 0·15 A. respectively. One feature of special interest is the breadth of the green line, which extends over 1·3 A. and has an intense core about 0·6 A. wide. These results were obtained at relatively unfavourable times, three or four years after the maximum in solar activity, and show that the methods employed will permit of the study of the red and green lines at any time, whilst it is quite possible that other lines can be obtained at times of greater activity.

The Positive Column.—Two accounts of the positive column which have just appeared, by R. Seeliger (*Physik. Z.*, April 1) and R. Holm (*Z. Phys.*, March 31), emphasise how unsatisfactory our knowledge of the passage of electricity through gases still is, even in the simplest cases. Langmuir has given a very full theory of the uniform positive column, and Schottky and Townsend less complete treatments, but attempts to compare these with experiment, except perhaps in the case of mercury, are limited both by lack of data for such discharge parameters as the temperature of the gas and of data for various atomic properties. Seeliger's article, which deals with monatomic gases, is largely an elaboration of Schottky's diffusion theory. Seeliger accepts the experimental result which lies at the basis of much of Langmuir's work, that the electrons have often a Maxwellian distribution of velocities corresponding to a temperature much in excess of that of the gas, and makes some interesting comments on how this temperature may be maintained. There are, however, special difficulties with the noble gases on account of the frequent occurrence of moving striations and the practical impossibility of finding the concentration of metastable atoms by other than delicate optical methods. Holm discusses diatomic gases, again starting from Schottky's theory, which he shows to be in reasonable agreement with his and Güntherschulze's measurements of the field in the positive column, but makes a distinct break from earlier work in his insistence on the importance of negative molecular ions, the conditions for the formation of which are still little understood.

Astronomical Topics

Comets.—An interesting point has arisen with regard to Newman's comet (1932 *f*). It appears that there are two comets, several minutes of arc apart, that have similar motion. This was first detected by Herr Schmitt, and was announced in a telegram from the I.A.U. Bureau on July 1. It is quite probable that some of the observations supposed to belong to Newman's comet actually belong to the other one. The following orbits of Newman's comet have been computed; the first is by Dr. Whipple and Mr. Cunningham from positions on June 1, 7, and 20 (*Harvard Card* 222), the second by Dr. M. Davidson from observations by Dr. W. H. Steavenson on June 21, 25, and 30:

T	1932 Sept. 27	1932 Sept. 25·01 U.T.	
ω	73° 50′	70° 9′ 16″	1932·0
Ω	244 50	245 7 33	1932·0
i	76 50	78 21 20	1932·0
q	1·57	1·6421	

Three positions are given below; the first is presumed to belong to Newman's comet, the second is the discovery position of Schmitt's comet. Dr. Davidson considers that the third also belongs to Schmitt's comet:

U.T.	R.A. 1932·0.	N. Decl. 1932·0.	Observer.	Place.
June 22·1454	15^h 33^m $44·4^s$	9° 12′ 10″	van Biesbroeck	Yerkes
25·8662	15 28 36	11 45	Schmitt	not stated
July 1·9666	15 16 59·8	15 0 56	Steavenson	Norwood

Schmitt gave the daily motion of his comet as $-1^m 40^s$, N. 35′, which was practically the same as that of Newman; it can scarcely be doubted that these two bodies are portions of a single comet that split into two portions at some date in the past, like Biela's comet; this would make it probable that the period of the comets is not very long. A search through the catalogues has not revealed any comet with similar elements; there is a distant resemblance to 1898 I (Perrine), but that has a period of three or four centuries.

Orbits of Double Stars.—*Circular* No. 86 of the Union Observatory, Johannesburg, contains a determination by Dr. R. T. A. Innes of the orbit of the star Innes 35, the duplicity of which he discovered in 1897; the position is R.A. 6^h $53·7^m$, S. Decl. 35° 22′ (1900). It is a very close binary, the greatest elongation being only 0·3″. It has now completed two revolutions since discovery, and the period is thus known with considerable accuracy. This, as Dr. Innes points out, is a help in finding the other elements; they run as follows; Period 16·5 years, periastron 1926·8, e 0·586, a 0·315″, i 56·3°, 269·7°, 116·4. Applying Eddington's mass-luminosity relationship, Innes finds a parallax of 0·040″, masses of 0·91 and 0·87 of the sun, and absolute magnitudes of 4·8 and 5·0. The apparent magnitudes are 6·8 and 7·0, the spectral type F5. The separation of the stars at periastron is only 0·07″, so that most of the observations are in the region near apastron. Dr. Innes gives a second paper, explaining his method of computing double-star orbits, which makes use of the $X.Y.$ Tables that he published in 1927; he adds a new table that gives the value of arc *minus* sine for various angles.

Norman Lockyer Observatory.—The Council of this Observatory has recently published its report for the year ended on March 31 last; great satisfaction is expressed at the large amount of work carried out by Dr. W. J. S. Lockyer and Mr. Edwards. The former has recently published in the *Monthly Notices of the Royal Astronomical Society* a study of the relation between the corona and the prominences; the latter has made a study of the spectra of stars of type B, and continued the work of deducing spectroscopic parallaxes which has been going on for some years. The collection of stellar spectra photographed at the Observatory now amounts to 6458. The chief event of the year has been the completion of the photographic equatorial presented by Sir Robert Mond (see NATURE, June 4, p. 838); it includes four Zeiss triplet lenses of different diameters, and has an electrically controlled driving clock by Messrs. Cooke, Troughton and Simms. An interesting photograph of a bright meteor passing the Pleiades was obtained with it by Dr. Lockyer on Jan. 11; it is reproduced in *Monthly Notices, R.A.S.* for March, and gives much information as to the changes of brightness exhibited by the meteor in its flight; unfortunately it was not observed visually, so the exact time of its appearance is not known. It will be remembered that Dr. Lockyer photographed another interesting meteor in 1922 (*Monthly Notices, R.A.S.*, vol. 83). The investigations at present in hand include studies of the spectra of ζ Tauri, β Canis Majoris, and 52π Aquarii; also of certain stars with bright hydrogen lines.

Robert Brown and the Cell Theory

THE Linnean Society has issued as an extract from its *Proceedings* (1931–32, pt. 2) the series of addresses delivered at the general meeting on Nov. 19, 1931, which took the form of the centenary celebration of Robert Brown's discovery of the nucleus of the vegetable cell. The brochure contains an account, by Mr. J. Ramsbottom, of Brown's life and botanical work, one by Mr. S. Savage of his connexion with the Linnean Society, the passage from the memoir containing Brown's account of his discovery, and an address, by Lieut.-Col. J. Stephenson on Brown's discovery in relation to the history of the cell theory.

The discovery was announced at the close of a paper "On the Organs and Mode of Fecundation in Orchideæ and Asclepiadeæ" read at the meetings of the Society on Nov. 1 and 15, 1831. The paper was afterwards printed in the Society's *Transactions*.

It was characteristic of Brown to refer incidentally in communications the main purport of which was taxonomic, to discoveries of fundamental importance. In 1809, in a monograph on the Proteaceæ, which he had studied in Australia, he indicates the true relation between endosperm and embryo in the seed. In 1825, to a description of the remarkable Australian Juncaceous tree, *Kingia*, he adds his observations on the structure of the ovule and female flower in the Cycads and Conifers, which established the distinction between the Gymnospermous and Angiospermous flowering plants. To Brown also is owed the recognition of the Brownian movement of small particles (1827), and of the streaming of protoplasm, which latter he observed in the staminal hairs of *Tradescantia* (1831) many years before the 'discovery' of protoplasm.

Brown described the nucleus as a more or less distinctly granular areola, generally somewhat more opaque than the cell membrane, to which it sometimes adheres, projecting into the cell cavity, but it is not infrequently central or nearly so. It was observed in several families of Monocotyledons and Dicotyledons. Brown was the essence of caution, but the remark of Prof. F. E. Weiss, after reading the extract from the memoir, that Brown was inclined to regard the nucleus as an attribute of all vegetable cells, is justifiable.

Lieut.-Col. Stephenson pointed out that in 1831 we have already no inconsiderable part of that body of doctrine that goes by the name of the 'cell theory'. It is incomplete, in that it has scarcely as yet been applied to animals, no account of the origin of cells has been given, and the emphasis is mainly on the cell wall. Between 1831 and 1838, through the activities of the Breslau school under Purkinje and the rival Berlin school led by Joh. Müller, cells had been described in all the chief tissues of the animal body; the production of new cells by division had been seen by Dumortier and other botanists, nucleus and nucleolus had been recognised, and animal and plant cells appreciated as equivalent structures. Purkinje had noted the absence of a special membrane in animal cells.

The cell theory was therefore practically established by the year 1838, and Lieut.-Col. Stephenson protested vigorously against the general use in lectures and textbooks of the phrase "the Cell-Theory of Schleiden and Schwann". He insisted that Schleiden's erroneous theory of endogenous cell formation, accepted by his pupil Schwann, was a distinctly retrograde movement. Schwann also conceived the erroneous idea of the origin of new cells in the intercellular substance; and his mode of comparison of the plant and animal cell tended to accentuate and to perpetuate the view of the cell wall as the chief and distinctive character of the cell. Schwann's "Microscopical Researches" was published in 1839. In 1850, Braun expressed the opinion that the cell was, properly speaking, the substance within the membrane; but it was 1861 before Max Schultze defined a cell simply as a particle of protoplasm containing a nucleus. Therewith Brown may be said finally to have come into his own. Among the builders of the cell theory he holds an honourable place. A. B. R.

The Value of 'Protective' Adaptations of Animals

ONE of the hypotheses on which the theory of natural selection is based consists in the interpretation of the coloration and general appearance of animals from the point of view of protection from enemies. The range of 'protective' devices considered to be sufficiently effective as factors in the selection is very great, but exact investigations aiming at proving that such devices actually protect their possessors are scarce.

Selectionists assume a discrimination in the choice of prey on the part of predators, and one of the methods by which the existence of such a discrimination can be tested obviously consists in studies on the food of predators, by analysing the contents of their stomachs. Results of the studies, however, can only be convincing if the series of records are sufficiently long to eliminate the accidental and to arrive at statistically sound conclusions. In this respect, the investigations on the contents of birds' stomachs undertaken by the U.S. Bureau of Biological Survey* are beyond reproach, for they cover a period of more than forty years (since 1885), during which about 80,000 birds have been examined and as many as 237,399 identifications of animals found in their stomachs made. A common objection to this method is that anything found in a bird's stomach would be in an unrecognisable state. This, however, proved to be a misconception, since most birds swallow their food whole, and even in the cases of the most fragile insects, such as butterflies, certain parts, for example, wing scales, are perfectly well preserved, so that an approximate identification is possible.

The first conclusion arising out of the accumulated data is that the animals serving as food for birds belong to all the systematic groups of the animal kingdom from Protozoa to mammals. Within the size limits, animals of practically every kind accessible to birds are preyed upon, so that no groups can be considered immune from their attacks. Still more significant is the conclusion, supported by abundant statistical data, that the number of captures from each group is in proportion to the abundance of animals of that group. The figures for insects are particularly striking. Records for Rhynchota, for example, constitute about 11 per cent of all records of insects found in the stomachs of birds, and the percentage of known species of Rhynchota in relation to all known insects is about 8 per cent; the respective

* Smithsonian Miscellaneous Collections, vol. 85, No. 7, "Effectiveness in Nature of the so-called Protective Adaptations in the Animal Kingdom, chiefly as illustrated by the Food Habits of Nearctic Birds". By W. L. McAtee. Pp. 201. (Washington, D.C.: Smithsonian Institution, 1932.)

figures for Lepidoptera are 9 and 15 per cent; for Coleoptera, 44 and 46 per cent; for Hymenoptera, 14 and 17 per cent; and so on. This means that various animals are captured by birds approximately in proportion to their numbers, and no selective discrimination between groups on the part of birds is apparent. In other words, the predation takes place in much the same way as if there were no such thing as protective adaptation.

As regards various devices interpreted by selectionists as protective, their value can be gauged by the relative abundance of animals with such devices in birds' stomachs. The data in this respect are very discouraging to selectionists. It is not surprising, of course, that animals with coloration harmonising with their surroundings are eaten freely, since this can be interpreted as the selection in action. Much more important is the fact that animals presumably protected by poisonous secretions are also consumed in proportion to their numbers and, therefore, cannot be said to enjoy any protection. A beetle, *Macrodactylus*, is definitely poisonous and many young birds are killed by eating it, but it is, nevertheless, eaten freely, and the advantage of being poisonous is not obvious. Again, all spiders are venomous, but the 10,000 records of spiders having been eaten by more than 300 species of birds emphasise the complete disregard by birds of this method of protection. All the members of the group of Rhynchota (bugs) are always regarded by selectionists as being specially well protected by their taste or unpleasant smell. The fallacy of this statement is made clear by the 22,395 records of Rhynchota found in stomachs, the percentage of the records being in close agreement with the relative abundance of these insects.

Bright and contrasting colours of insects are usually considered as 'warning', and the Coccinellid beetles, or ladybirds, represent a classical example of 'warning coloration', possibly developed by selection and serving to advertise their unpalatability. There are, however, 1455 records of Coccinellids found in the stomachs of 127 species of birds; since up to 15 insects have been found in one stomach, their 'warning' coloration and the inedibility must be a fiction. Another equally well-known example of a specially protected group of insects is represented by the ants, and their immunity from attacks is said to be so great that many other arthropods secure protection from enemies by mimicking ants. The 12,000 records of ants eaten by well over 300 species of birds make the status of ants as a protected group untenable. Some birds eat ants in very large numbers, and up to 2000 ants have been found in one stomach. It is particularly noteworthy that even ants of the family Myrmicidæ, notorious for their stinging habit, are not avoided, as is shown by 1200 records of their presence in stomachs, containing in some cases up to 400 individuals. Wasps are considered also as regular models for mimicry, being themselves presumably well protected by sting and also 'warningly' coloured, but 140 species of birds eat them, up to 30 wasps at a meal.

The whole book is full of examples of this kind, most carefully collected and thoroughly analysed, and represents an array of arguments of which selectionists will find it very difficult to dispose. The principle of proportional predation is exhibited so clearly and forcefully that a discrimination in the choice of prey by birds (and other vertebrates, also considered in the paper) is shown to be simply non-existent. Indeed, the data at hand denote a complete indiscrimination, the very antithesis of selection, and the phenomena classed by theorists as protective adaptations are shown to bear no relation to the survival of the fittest.

B. P. U.

Aluminium in Foodstuffs

THE meeting of the Society of Public Analysts on June 1 was devoted to papers on the effects and estimation of aluminium in foodstuff.

A survey of the physiological effects of aluminium was given by Dr. J. H. Burn. He said that the first extensive investigation of the physiological effects of aluminium salts was made in 1886 by Siem, working under Prof. H. H. Meyer. Siem found that doses corresponding with 30-40 grains of alumina for a man had no effect whatever when administered by mouth to cats daily for four weeks. When the aluminium salt was injected under the skin, the fatal dose varied from 0·25 to 0·30 gm. of alumina per kilogram. These results, indicating that aluminium has some toxicity when injected, but is harmless by mouth, have in substance been confirmed by many subsequent workers.

Siebert and Wells examined the pathological changes produced by injecting alum and aluminium chloride; they found that anæmia was manifested after nine or ten daily injections, a fall in the hæmoglobin percentage and in the red cell count being recorded. In the spleen, pigmentation, thrombosis, and fibrosis were observed.

The experiments of McCollum and his colleagues, and those of Myers and Mull, show conclusively that the addition of aluminium salts to the diet of young rats has no ill effect on growth, health, and reproduction, even when four successive generations are observed. The experiments of Myers and Morrison, and of Underhill and Peterman, show that when aluminium compounds are given by mouth to dogs, only insignificant changes in the amounts of aluminium in different tissues are found. It follows that aluminium salts are not absorbed from the alimentary tract, except in traces.

As a result of a scare in the United States that the use of aluminium baking powders was dangerous to health, the Department of Agriculture instituted a board of inquiry. The report, published in 1914, described experiments on twenty-six university students carried out in three different universities, who were given amounts of alum varying from 0·2 gm. to 10 gm. daily for about six months. It was unanimously reported from the results of these experiments that the amounts of alum likely to be consumed as a result of alum in baking powder, estimated as up to 1·16 grain of aluminium per person per day, are much too small to have any ill effect. The amounts of aluminium which arise from aluminium vessels were estimated from analyses carried out by Massatch to be about 0·1 grain per person daily.

Indeed, the possible dangers arising from aluminium utensils have been very thoroughly investigated by many workers, on many species of animals; they have also been investigated with equal thoroughness on man. These dangers are non-existent. Clinical reports that symptoms of abdominal pain are relieved by discontinuing the use of aluminium can be ascribed to psychological effects.

Dr. L. H. Lampitt and Mr. N. D. Sylvester outlined a method for the accurate determination of small amounts of aluminium in foodstuffs, in which the Aurin tricarboxylic acid lake is formed under standardised conditions, the red colour of the final solution being measured in the Lovibond tintometer. Separation of aluminium from the 'wet ash' of the foodstuff is effected by a preliminary precipitation

with ammonia, the aluminium being obtained in alkaline solution. Other metals which are liable to be present have been proved not to interfere. The actual determination is carried out on an aliquot portion containing 0·01-0·06 mgm. of aluminium. Using 20 gm. of sample, so little as 0·2 part per million of aluminium can be determined.

The results obtained indicate that the aluminium content of foodstuffs is increased by only a few parts per million after cooking in aluminium utensils. For example, the aluminium content of milk was increased from 0·4 to 0·6 part per million after boiling in an aluminium saucepan, and to 2·5 parts per million after standing overnight. Apples before cooking contained 2 parts per million of aluminium, and after boiling in an aluminium vessel for thirty minutes with sugar and water they contained 14 parts.

Mr. P. L. Bilham described a spectrographic method for the determination of small quantities of aluminium. The aluminium of a biological material is concentrated on to a special electrode. The spectrum is then excited by a condensed spark discharge, modified to remove air-lines as much as possible, and a quartz spectrograph is employed to photograph the spectrum. The plate is developed under standard conditions and then compared with sets of standards on plates prepared under precisely similar conditions. The results show that aluminium is detectable down to 0·01 mgm., and that the intensities of the lines at 3944 A. and 3961·5 A. can be used to judge the amount present up to 0·2 mgm. The method is, of course, specific for aluminium and of a reasonable accuracy.

Carnegie Grants for Libraries and Museums

THE eighteenth annual report of the Carnegie United Kingdom Trust, for the year ended Dec. 31, 1931, has recently been issued.* The opening paragraphs reflect the influences of the financial position of the country upon policy, inasmuch as the main object of the trustees in the immediate future will be one of consolidation rather than the inauguration of new and pioneer schemes. In their view, the urgent demand for drastic economy in national and local expenditure, coupled with the restriction of private generosity, compels limitations of policy. Grants from the Trust will be made in order to maintain and stabilise activities which have already been assisted and have themselves tended to move forward under their own momentum. But grants for entirely new purposes are to be few in number, and to be made only for exceptionally strong and urgent reasons. These decisions, however prudent, must inevitably bring disappointment in various quarters, but, at any rate, they cannot fail to be understood.

Though most people are aware how wide the net is cast, it may be useful and opportune at this juncture of affairs to recall some of the more important schemes which have received allocation of revenue. Outstanding among these is the acquisition of freehold property in Bloomsbury, intended to form the headquarters of the National Central Library and of the Library Association, in an area contiguous to and ultimately destined for occupation by the new buildings of the University of London. The total sum contemplated for this undertaking is large, amounting in fact to about £60,000. It is believed that the two institutions, housed as neighbours, will play an essential part in completing the unification of the nation's library service. For the first time in its history the Library Association will be in possession of premises of its own, large enough for practical operations, and consistent with its dignity as a national body established by Royal Charter. It is hoped that the quarters will be ready within about eighteen months. Complementary in interest is the information that the trustees are still prepared to receive applications on behalf of municipal libraries serving populations between 10,000 and 70,000. Aid is given for book-purchase only, and will be made to such authorities as are prepared to carry out, as fully as financial conditions permit, the main principles of approved modern practice.

Substantial grants have been allotted to various research associations and societies—among these we note British Non-Ferrous Metals, Wool Industries, Linen Industry, British Rubber Manufacturers, British Flour Millers, London School of Economics, Entomological Society, Society for Psychical Research. Rural and Social Service includes schemes affecting community centres, boys' and girls' clubs, youth hostels, and village halls. Enterprises relating to activities in the departments of music and drama have received attention ; while the sympathy and support extended to rural preservation schemes and playing fields is a record of much interest.

The trustees' 'museum policy', initiated rather more than two years ago, is still in the experimental stage, and there may be a temporary period of inaction. Thirteen centres had accepted or been offered grants up to the end of 1931 for reconstruction purposes. These grants are conditional upon the adoption of a scheme prepared by an expert appointed by a joint committee of the Trust and the Museums Association. The substitution of modern cases, the disposal of miscellaneous and irrelevant material, adequate display and labelling, coupled with the adoption of a progressive policy on the lines recommended in Sir Henry Miers's report, are essential considerations.

Finally, the remarkable development of county libraries, closely fostered by the Library Association, established in local areas, demands a few words. Throughout Britain generally the story is one of judicious expansion. At the end of the year 1930–31, some sixteen millions of the population of the United Kingdom were served through 14,000 library centres, almost all of which were administered by voluntary librarians and enlisted voluntary helpers. In no other country as yet could it be stated that any village librarian, in addition to his periodic supply of anything from 50 to 2000 books, can obtain for borrowers access not only to the county stock of, say, 50,000-150,000 volumes, but also through the county headquarters to nearly 5,000,000 volumes held or procurable by the National Central Library, and that, as a rule, special books may be sent by post for private study.

* The Carnegie United Kingdom Trust. Eighteenth Annual Report (for the year ending December 31, 1931), approved by the Trustees on March 11, 1932. Pp. ii+95+4 plates. (Dunfermline.)

University and Educational Intelligence

CAMBRIDGE.—The governing body of King's College, having made provision for four additional fellowships open for competition to graduate members and research students of the University, is offering a fellowship to be associated with the name of the late Mr. E. B. Stringer. Candidates must be members of the University, less than thirty years of age on March 1, 1933, who have worked in (i) chemistry, (ii) experimental physics, or (iii) the chemistry or physiology of plant or animal life. Applications should reach the Provost by Nov. 1.

DUBLIN.—At a meeting of the Senate of the University of Dublin, Trinity College, on June 29,

honorary degrees were conferred upon the following, among others: *M. Eng.*—Prof. F. S. Rishworth, professor of civil engineering in University College, Galway. *D.Sc.*—Prof. R. G. Harrison, professor of biology in the Yale University; and Prof. T. M. Lowry, professor of physical chemistry in the University of Cambridge. *LL.D.*—Prof. W. R. Scott, Adam Smith professor of political economy in the University of Glasgow.

EDINBURGH.—At the graduation ceremonial on June 30 the honorary degree of Doctor of Laws was conferred upon the following, among others; Prof. C. V. Boys, Mr. H. M. Cadell; Mr. D. M. Greig, conservator of Museum, Royal College of Surgeons, Edinburgh; Dr. R. S. MacDougall, formerly reader and Steven lecturer in agriculture and forest entomology in the University; Mr. Andrew Mellon, United States ambassador; Prof. A. Robinson, emeritus professor of anatomy in the University; Sir Archibald Sinclair, Secretary of State for Scotland; and Sir Josiah Stamp.

The following were admitted to the degree of Doctor of Science, titles of theses appearing after the names: Mr. S. C. Devadatta, "The Distribution of Lactate between the Corpuscles and the Plasma in Blood"; Dr. Honor B. Fell, "Morphological and Experimental Studies on the Skeletogenesis of the Fowl"; Mr. D. Finlayson, "Some Physical Problems associated with the Internal Combustion Engine"; Mr. D. S. MacLagan, "An Ecological Study of the 'Lucerne Flea' (*Smynthurus viridis*, Linn.)"; Dr. D. Meksyn, "Electromagnetic Phenomena in the General Theory of Relativity"; Mr. H. S. Ruse, "Theorems in the Tensor Calculus"; Dr. R. H. Slater, "Synthesis of Quinoline Compounds of possible Therapeutic Value".

At the close of the ceremony, the Principal, Sir Thomas Holland, referred to two medallions by Emeritus Professor Schlapp, representing Sir Walter Scott and Thomas Carlyle as students, which have been placed in the McEwan Hall. Walter Scott matriculated in the University in 1783, attended classes for three years but failed in Greek, and his father took him away to his own business. Scott returned in 1789, studied in the Faculty of Law and was admitted to the Faculty of Advocates in 1792. At the age of fourteen years, in 1809, Thomas Carlyle trudged from Ecclefechan to the University of Edinburgh. He seemed to have profited mainly from the teaching of the professor of mathematics, and later in life, just after he had failed to persuade any publisher to accept "Sartor Resartus", he made an unsuccessful attempt to obtain the professorship of astronomy in the University. He was rejected, and that incident probably turned him finally to letters.

LONDON.—The following doctorates have been conferred: D.Sc. in anthropology on Dr. E. J. Dingwall (University College) for two works entitled "Male Infibulation" and "Artificial Cranial Deformation" (Bale, Sons, and Danielsson, 1931); D.Sc. in chemistry on Mr. J. W. Smith (University College) for a thesis entitled "Studies in Intensive Drying and Related Phenomena" (*J. Chem. Soc.*, 1929 and 1931; *Phil. Mag.*, 1929); D.Sc. (Engineering) on Mr. H. C. H. Townend (Northampton Polytechnic Institute) for ten contributions to the study of aerodynamics.

ST. ANDREWS.—Amongst those who received the honorary degree of LL.D. at the graduation ceremonial on June 28 were Sir James Frazer, author of "The Golden Bough", Dr. Albert Schweizer, and Prof. L. R. Sutherland, emeritus professor of pathology in the University.

Calendar of Geographical Exploration

July 11, 1616.—Samuel de Champlain

Samuel de Champlain, the great French explorer, returned to Quebec, which he had founded in July 1608, after his third and greatest journey. He set out in 1615 and, travelling down the Ottawa and Mattawa Rivers, Lake Nipissing, and French River, reached Georgian Bay. Thence he proceeded inland and explored Lake Ontario. Champlain's earliest voyages were to the West Indies and Mexico. In 1603 he travelled up the St. Lawrence, and in the following years surveyed the coasts of Nova Scotia, the Bay of Fundy, and the mainland so far as Cape Cod. In 1613 he reached Allumette Island in the Ottawa River, in an endeavour to discover a supposed short route to the ocean via the Ottawa River. Lakes Champlain, Nipissing, and Simcoe were discovered by him, and he made further journeys on Lakes Huron and Ontario, which had been visited a few years earlier by Brulé. Interestingly enough, Champlain contemplated, during a visit to Panama, the project of a ship canal across the isthmus.

July 11, 1897.—First Air Attempt on the North Pole

S. A. Andrée, a Swedish aeronaut, with two companions and about five tons of supplies, set out in a balloon for the north pole. Heavy guide-ropes dragging over the ice were to be used for steering. Andrée had already made successful flights in this way. Rising from Danes Island, Spitsbergen, at 2.30 P.M., the balloon passed out of sight within an hour. A buoy containing a message that at 10 P.M. the balloon was in 82° N., 25° E., moving towards the north-east at an altitude of 800 ft., was found. But until Aug. 22, 1930, nothing more was known of the fate of Andrée and his companions. On that date, members of an expedition to White Island found their bodies and their diaries. They had reached 82° 56′ N., but had been compelled to return on foot, and had died at Gilos Land, White Island, to the east of Spitsbergen.

July 13, 1102.—An Early Pilgrimage to Jerusalem

Saewulf, or Saewlf, an Anglo-Saxon native of Worcester, a merchant, took ship at the little harbour of Monopoli, near Bari, for his pilgrimage to the Holy Land. The effect of the Crusades was to encourage such pilgrimages, and Saewulf, though not the first to make the journey, was the first who left a narrative of it. His outward journey was made direct from Italy to the Ionian Islands, from Negropont to Rhodes, and thence to Palestine. His record shows the great increase of European influence in the Levant in war, commerce, and pilgrimage; his account of the destruction of pilgrim and trading vessels in Jaffa during a great storm is specially valuable from this point of view. His description of the sites of Hebron is detailed and interesting. Among other places, he visited Nazareth and Cana of Galilee. He embarked on his return journey at Joppa, coasted down past Tyre, Sidon, and Acre, touched at Cyprus, and put in at Rhodes. There he changed to a smaller vessel and later to another, and proceeded through the Dardanelles. The narrative breaks off abruptly at the point when Saewulf was near Constantinople and wished to worship there before returning home. Inevitably, many of Saewulf's historical explanations seem quaint to modern students, but his narrative throws a good deal of light on conditions in his time.

July 13, 1909.—Mikkelsen's Voyages

Ejmar Mikkelsen left Thorshavn in the *Hekla*, in command of an expedition to explore north-east Greenland. Mikkelsen had, with Amdrup, explored

the east coast of Greenland in 1900, worked with the Baldwin-Ziegler 1901–2 expedition in Franz Josef Land, carried out oceanographical survey in the North Atlantic in 1903–4, and, in joint command with Leffingwell, explored northern Alaska in 1906–8. In 1908–10 Mikkelsen discovered the records left by Mylius-Erichsen of his tragic journey of 1907.

July 13, 1923.—American Scientific Expeditions to Mongolia

George Olsen, a member of one of the above expeditions, found the first complete dinosaur eggs. The theory that Central Asia must have been a centre of origin for ancestral types of mammalian life aroused the interest of Prof. Henry Fairfield Osborn, president of the American Museum of Natural History, and eventually led to the organisation of a series of remarkably well equipped scientific explorations of the region of Mongolia which lies between the Kalgan and the Altai Mountains. Palæontology, geology, palæobotany, archæology, topography, zoology, and photography were all represented in the 1925 expedition. But palæontology took first place in the 1922–23 expedition, which justified the theory in such a remarkable way. Dr. R. C. Andrews, the leader of the expeditions, reports that the major geographical features of the Gobi have been determined, and a surveyed line of more than 1000 miles has been run north-west through the heart of the desert.

July 15, 1836.—Sir T. Livingstone Mitchell in Australia

Sir T. L. Mitchell discovered the Grampian Hills, on a journey in Australia during which he also discovered the Wimmera and Glenelg Rivers and cleared up the main features of the Murray-Darling basin east and south of the Darling. Mitchell's explorations in Australia began in 1831, and to him and Sturt is due the elucidation of the drainage system of south-eastern Australia. In 1846 he crossed the Carnarvon Range and discovered the upper portion of the Barcoo River.

July 15, 1874.—The Road to Lhasa

The famous Indian explorer, Nain Singh, left Leh on a journey through western Tibet to Lhasa and the region south of that city. He travelled 1319 miles, of which about 1200 were across country never previously explored, and made detailed surveys of the route. Numerous lakes were discovered, as was the existence of a vast snowy range parallel to and north of the Brahmaputra River. Of this range, Nain Singh recorded the position of several peaks and estimated their heights. Nain Singh on his previous memorable journey had made a route survey of the road between Katmandu and Tradom and of the great Tibetan road from Lhasa to Gartok. He had traced much of the upper course of the Brahmaputra, and made estimates of the heights of various mountain peaks.

July 16, 1906.—Sven Hedin in Central Asia

Sven Hedin, the famous Swedish explorer, started from Srinagar on his journey to the region lying between Shigatse and Leh, and north of the Brahmaputra. He discovered a range of mountains lying parallel to the Himalayas on the Tibetan side, and mapped this previously unknown region. In 1893–97, Hedin crossed the desert between the Yarkand and Khotan Rivers, discovered the buried cities of the Takla Makan, and found that Lob Nor had changed since Przhvalsky visited it. In 1899–1902 he surveyed the Yarkand River and much of northern Tibet. Apart from his archæological work, Hedin made great contributions to the mapping of central Asia, and especially of the sources of the Sutlej and Brahmaputra.

Societies and Academies

LONDON

Royal Society, June 30.—J. W. Cook, I. Hieger, E. L. Kennaway, and W. V. Mayneord: The production of cancer by pure hydrocarbons (1). Tests for cancer-producing action on mice are in progress, or have been completed, with preparations of the following polycyclic aromatic hydrocarbons composed entirely of benzene rings:—(1) All the six possible four-ring compounds, (2) all the ten known compounds out of the fifteen possible five-ring compounds, (3) some compounds containing six and eight rings, and others. Some of the hydrocarbons examined are of very low solubility, and hence all tests carried out with them are unsatisfactory. No hydrocarbon in the pure state has produced cancers except 1 : 2 : 5 : 6-dibenzanthracene and some closely related compounds. It produced cancer of the skin when applied in a concentration of 0·003 per cent in benzene.—**J. W. Cook**: The production of cancer by pure hydrocarbons (2). Preliminary results suggest that 6-*iso*-propyl-1 : 2-benzanthracene is carcinogenic, and a pure sample of this has been synthesised and is being examined for carcinogenic activity, together with other *iso*-propyl and methyl derivatives of 1 : 2-benzanthracene. 5 : 6-*cyclo*penteno-1 : 2-benzanthracene produced metastases in the axillary glands and lungs in four mice to which it was applied. There is evidence that a molecular structure consisting of new rings attached to the 1 : 2- and 5 : 6- positions of the anthracene ring system is particularly efficacious in promoting carcinogenic activity.—**G. H. Eagles and A. H. H. Kordi**: The cultivation of vaccinia virus: a new series of subcultures in cell-free medium. The cell-free medium has been prepared with the view of obtaining from adult rabbit kidney an extract rich in cell substance while eliminating the presence of actual cells. The medium must be freshly prepared. Vaccinia virus has been propagated in this medium through ten subcultures in one series, representing a multiplication of 10^{30} times the original culture with a dilution of 10^{17} of the virus content of the original culture. Though greater irregularity in growth occurs in cell-free medium than in medium containing living cells, experience has shown that with the former substantial yields of virus have been realised.

Physical Society, May 20.—A. O. Rankine: (1) On the representation and calculation of the results of gravity surveys with torsion balances. An alternative method of indicating the functions of the Eötvös torsion balance, and of calculating those quantities, depending upon the distortion of the earth's gravitational field which the balance measures, is described and a convenient method is indicated of applying graphically the necessary corrections for the effects of the earth's rotation and irregularity of the surface of the ground. —(2) Some observations with a gravity-gradiometer. An account is given of a series of observations with a Shaw and Lancaster-Jones gravity-gradiometer, during which it was discovered that very persistent, although small, electric charges could be developed on the mica ring forming part of the oscillation-damping system. Such charges, which may persist for weeks, may not arouse suspicion, although in fact they lead to spurious results in the normal use of the instrument.—**R. L. Smith-Rose and J. S. McPetrie**: The propagation along the earth of radio waves on a wave-length of 1·6 metres. A description is given of the simple transmitting and receiving apparatus which has been employed for the experiments on this wave-length. Measurements of the field-intensity at different distances from the transmitter have been carried out

for various heights of the apparatus above the ground level. When both transmitter and receiver are used very close to the ground, the attenuation curve obtained is similar to that encountered at longer wave-lengths. When, however, the apparatus is elevated by an amount comparable with, or greater than, the wave-length, the field-intensity distance curves have maximum and minimum values, the positions of which depend upon the actual heights employed. These maxima and minima are due to interference between waves transmitted directly from the transmitter to the receiver and those which arrive at the receiver after reflection from the earth's surface.—**Allan Ferguson** and **S. J. Kennedy**: Notes on surface tension measurement. This paper deals with a method for the accurate determination of the surface tension of liquids available in volumes of not more than one or two cubic millimetres. The method described does not involve any knowledge of the density of the liquid. A series of measurements of the variation with concentration of the surface tension of aqueous solutions of *p*-toluidine are also described. Here, also, the method employed is independent of a knowledge of the density of the solution.—**D. K. McCleery**: The fall of potential in a charged insulated cable. The expansion theorem of Heaviside is applied to the solution of the problem in which a cable, having been charged until it reaches its steady state, is insulated at the sending-end, and the potential is required at any point and at any time after insulation. At the sending-end there is an initial steep fall of potential which is due to a part of the charge being drained away from this end, in order to equalise the potential throughout the line when the exciting source has been removed. After the potential has become uniformly distributed, it falls with time according to a simple exponential law.

DUBLIN

Royal Irish Academy, May 23.—**Joseph Algar, Anne E. O'Reilly,** and **Mary Joy**: Some derivatives of dicoumarin. When diacetoresorcinol is heated for five hours with acetic anhydride and the sodium salt of phenylacetic acid, a good yield of α-α′-diphenyl-β-β′-dimethyl-dicoumarin, m.p. 276°-277° C., is obtained. By employing the sodium salts of substituted phenylacetic acids a number of dicoumarin derivatives may be prepared, the yields being satisfactory in most cases.—**Joseph Algar, Vincent C. Barry,** and **Tadhg F. Twomey**: Derivatives of benzo-difurfurane. The condensation of bromacetic ester with diacetoresorcinol gives the diethyl ester of diacetoresorcinoldiacetic acid (m.p. 130°-131° C.), which on hydrolysis affords the corresponding acid (m.p. 264°-266° C.). The latter is converted into β-β′-dimethyl-benzo-difurfurane (m.p. 107°-108° C.) by heating with acetic anhydride and sodium acetate. Various derivatives were obtained.

PARIS

Academy of Sciences, May 23 (vol. 194, pp. 1769-1868).—**L. Cayeux**: The condition and diffusion of phosphoric acid in old sedimentary formations. Consequences.—**Charles Achard, Mlle. Jeanne Lévy,** and **Fernand Gallais**: Experimental researches on some colloidal modifications produced in the blood serum by the injection of concentrated serum and by plasmatic bleedings.—**Armand de Gramont** and **Daniel Beretzki**: The temperature of a piezo-electric crystal as a function of its vibratory regime.—**Georges Claude**: The extraction of the dissolved gases in the Claude-Boucherot method.—**Maurice Fréchet**: Remarks on the probabilities of events in sequence.—**T. Wazewski**: The stability of the integrals of a system of differential equations.—**Alex. Froda**: Measurability in support of functions of real variables.—**G. Valiron**: Some consequences of Ahlfors' theorems.—**M. Delfosse** and **R. Swyngedauw**: The measurement of the friction couple of an axle in its bearing.—**M. Mendes**: The application of the method of variation of constants to the problem of *n* bodies with variable masses.—**V. Smirnoff** and **S. Soboleff**: Some problems of elastic vibrations.—**Mlle. Jacqueline Hadamard**: Perfecting a high precision Nernst bridge.—**Maurice Fallot**: The atomic moments and Curie points of ferro-silicon. Superstructures.—**Pierre Lacroute**: The method of using a large Rowland grating and the study of its faults.—**R. Lucas** and **Mlle. D. Biquard**: The influence of solvents and of temperature on the rotatory powers and dispersions of active bodies.—**Marcel Cau**: The rôle of multiple reflections in the magneto-optic Kerr effects of thin layers of iron.—**M. Chatelet**: Some organic solutions of iodine. Studies of the absorption spectra of iodine in some mixtures of solvents.—**Trajan D. Gheorghiu**: The influence of diffused light on photoelectric measurements.—**G. Mano**: The slowing down of the α-rays in air and Bethe's theory.—**P.** and **M. Lecomte du Noüy**: Studies on the critical temperature of serum. The absorption spectrum of horse serum in the ultra-violet. A curve is given showing the changes in the ultra-violet absorption spectrum produced by heating to 55° C. and 65° C.—**Mme. L. Walter-Lévy**: Contribution to the study of the system MgO, CO_2, H_2O at the temperature of 100° C.—**E. Vellinger**: Contribution to the study of dissociation phenomena in organic media.—**Jean Cournot** and **Marcel Chaussain**: The determination of the loss of weight in corrosion tests. The usual method of cleaning the test specimen by brushing, washing, and drying is shown to be inexact; two alternative methods are described.—**Neda Marinesco**: The action of an oscillating piezo-quartz on sols and suspensions. The ultra-sonic thixotropism of gels.—**Lucien Semichon** and **Michel Flanzy**: The application of chromic oxidation to some mono-acids. Detailed study of the oxidation of volatile fatty acids, and of hydroxy and ketonic acids.—**G. Vassiliadès** and **L. Capatos**: The action of diethylamine on methyl acetylene-dicarboxylate.—**Charles Dufraisse** and **Maurice Loury**: Researches on the dissociable organic oxides. The isomerism of the dimethylrubrenes and the constitution of the rubrenes.—**P. Carré**: The relative mobilities of the radicals in the chlorides of acid alkyl sulphites (R.O.SO.Cl). From a study of the temperatures at which these chlorides decompose in the presence of pyridine, the comparative mobilities of the radicals has been obtained. The mobility of the aryl groups is lower than that of the alkyl groups.—**Ch. Courtot, M. Chaix,** and **J. Kelner**: The mechanism of the action of sodium amide on diphenylsulphinone.—**Louis Meunier** and **M. Gonfard**: The analysis and some properties of the benzylcelluloses.—**J. Duclaux** and **M. Hugon**: The transparency of the pure atmosphere. A study of the limiting distance of vision as a function of the wave-length.—**P. Chofardet**: The transparency of the air. A statistical study of the results of nineteen years' observations on the visibility of Mount Blanc from two stations (Chailluz, Montfaucon).—**Paul Corsin** and **Georges Dubois**: The characters of the Dinantian culm-flora of Champenay in the upper valley of the Bruche.—**A. N. J. Heyn**: Researches on the plasticity of cellular membranes and the growth of plants.—**W. A. Becker**: Experimental researches on cytokinesis and the formation of the cellular plate in the living cell.—**Louis Gallien**: Neotenic reproduction in *Polystomum integerrimum*.—**Mlle. S. Firley** and **M. Fontaine**: The proportion of proteins in the serum of the eel and its variations in the course of changes in salinity.

—**Ph. Lasseur, A. Dupaix,** and **L. Georges** : Remarks on the Boas phenomenon.—**Georges Deflandre** : The Archæmondaceæ, a new family of marine fossil protists with siliceous covering.—**G. Delamare** and **C. Gatti** : Spirochetes and intraleucocytary annular bodies.—**J. Lignières** : *The variability of the pathogenic and* immunising quality of the aphthous virus.—**S. Nicolau** and **Mme. L. Kopciowska** : The elective zone for the Negri bodies in rabbits dying of experimental hydrophobia with fixed virus.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, vol. 18, No. 3, March 15).—**A. Einstein** and **W. de Sitter** : On the relation between the expansion and the mean density of the universe. The density derived on the assumption of zero curvature is of the right order of magnitude.—**Marston T. Bogert** and **David Davidson** : Azo derivatives of the pyrimidines.—**L. F. Randolph** : Some effects of high temperature on polyploidy and other variations in maize. The ear-shoot region was enclosed in a wire mesh cylinder and heated by an electrical heating pad to 38°-45° C. for a period of an hour at a time during the 48 hours beginning 27-30 hours after fertilisation. Among the effects observed were the doubling of entire chromosome sets, chromosomal deficiencies and translocations, direct morphological effects such as defective seedlings, and various deviations from the normal fertilisation process. It is suggested that since organisms in Nature are subjected to even higher temperatures than those used in the experiments, high temperatures may have played an important part in the natural production of variations.—**Henry Margenau** : Note on the quantum dynamical correction of the equation of state. A correction.—**W. G. Penney** : Effect of nuclear spin on the radiation excited by electron impact. No theory of polarisation of radiation excited by this means can be complete without taking into account nuclear spin. Calculations for mercury λ2537 give results not in agreement with the experimental data available ; the first order cross-section and approximate wave functions are not sufficiently accurate.—**E. H. Kennard** : Entropy, reversible processes, and thermo-couples. A discussion, with two examples, suggesting that the usual statement to the effect that a reversible process never changes the entropy of the universe is valid only when the process can be isolated completely from all other processes.—**P. W. Bridgman** : Comments on the note by E. H. Kennard on "Entropy, reversible processes, and thermo-couples".—**Francis D. Murnaghan** : On the field of values of a square matrix.—**Aurel Wintner** : Remarks on the ergodic theorem of Birkhoff.—**E. B. Stouffer** : A geometrical determination of the canonical quadric of Wilczynski.—**B. O. Koopman** and **J. v. Neumann** : Dynamical systems of continuous spectra.—**J. v. Neumann** : Physical applications of the ergodic hypothesis.—**Edward Kasner** : Complex geometry and relativity : theory of the 'rac' curvature. Rac curvature or 'rac' for a given curve is defined as the limiting ratio of arc to chord. For ordinary real curves rac equals unity, but for certain imaginary curves it has other values, the chief of which is $\frac{4}{3}\sqrt{2}$. In space of more than two dimensions, curves can be constructed such that it has any assigned value. In general, the rac curvature changes discontinuously if the point moves continuously along the curve or the curve is varied continuously.—**Hassler Whitney** : Regular families of curves (1).—**G. D. Birkhoff** and **B. O. Koopman** : Recent contributions to the ergodic theory.—**J. Shohat** and **J. Sherman** : On the numerators of the continued fraction

$$\frac{\lambda_1|}{|x-c_1} - \frac{\lambda_2|}{|x-c_2} - \dots$$

Forthcoming Events

SATURDAY JULY 9

SOCIETY OF CHEMICAL INDUSTRY—South Wales Section (Special Joint Meeting with the South Wales Section of the Institute of Chemistry at the laboratories of the Cardiff Gas, Light and Coke Company, Bute Terrace, Cardiff), at 3 P.M.

WEDNESDAY, JULY 13

SOCIETY OF CHEMICAL INDUSTRY (Annual Meeting at Nottingham), at 10.15.—Prof. G. T. Morgan : "Ourselves and Kindred Societies" (Presidential Address).

THURSDAY, JULY 14

SOCIETY OF CHEMICAL INDUSTRY (Annual Meeting at Nottingham), at 10.—Sir William Pope : "Forty Years of Stereochemistry" (Messel Memorial Lecture).

INSTITUTION OF WELDING ENGINEERS (in conjunction with the Acetylene and Welding Consulting Bureau at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1).—Exhibition of a film dealing with practical applications of oxy-acetylene welding, at 2.30 P.M.

Official Publications Received

BRITISH

Proceedings of the Linnean Society of London, Session 1931–32. Part 3. Pp. 57-72. (London : Linnean Society.) 6*d.*

Empire Cotton Growing Corporation. Report of the Eleventh Annual General Meeting. Pp. 18. (London.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 21 : Report of the Irish Radium Committee for the Year 1931 ; including Reports by Oliver Chance, John A. Geraghty, Oswald J. Murphy, C. Conor O'Malley, Dr. Bethal Solomons, Sir Robert Woods. Pp. 249-266. (Dublin : Hodges, Figgis and Co. ; London : Williams and Norgate, Ltd.) 1*s.* 6*d.*

The Institute of Chemistry of Great Britain and Ireland. Register of Fellows, Associates and Students, 1932. Pp. 396. (London : Institute of Chemistry.)

Commonwealth of Australia : Council for Scientific and Industrial Research. Pamphlet No. 25 : Termites (White Ants) in South-eastern Australia ; a Simple Method of Identification and a Discussion of their Damage in Timber and Forest Trees. By Gerald F. Hill. Pp. 28. Pamphlet No. 26 : The Irrigation of Horticultural Community Settlements ; Notes for the Guidance of Advisory Boards in Murray Valley Settlements. By A. V. Lyon. Pp. 22. (Melbourne : H. J. Green.)

Indian Central Cotton Committee : Technological Laboratory. Technological Bulletin, Series A, No. 20 : Spinning Tests on Mixings of Long Staple and Short Staple Indian Cottons. By Dr. Nazir Ahmad. Pp. ii+21. (Bombay : The *Times of India* Press.) 1 rupee.

The National University Handbook, 1908–1932. Pp. xi+288+50 plates. (Dublin.)

British Non-Ferrous Metals Research Association. Twelfth Annual Report for the Year ending December 31st, 1931. Pp. 54. (London.)

FOREIGN

Department of Agriculture : Straits Settlements and Federated Malay States. General Series, No. 8 : Investigations on Coconuts and Coconut Products. By F. C. Cooke. Pp. x+99+9 plates. (Kuala Lumpur.) 1 dollar.

Philippine Earthquake Epicentres (1920 to 1929), South of Manila. By Rev. William C. Repetti. Pp. 35-52. (Manila : Bureau of Printing.)

Smithsonian Institution : United States National Museum. Bulletin 160 : Mexican Tailless Amphibians in the United States National Museum. By Remington Kellogg. Pp. iv+224+1 plate. (Washington, D.C. : Government Printing Office.)

Japanese Journal of Geology and Geography. Transactions and Abstracts, Vol. 9, Nos. 3 and 4, March. Pp. 141-266+7-23+6. (Tokyo : National Research Council of Japan.)

U.S. Department of Commerce : Bureau of Standards. Research Paper No. 422 : Accelerated Weathering Tests of Soldered and Tinned Sheet Copper. By Peter R. Kosting. Pp. 365-379+11 plates. (Washington, D.C. : Government Printing Office.)

Proceedings of the United States National Museum. Vol. 79, Art. 28 : Revision of the Chalcid Flies of the Tribe Decatomini (Eurytomidae) in America north of Mexico. By W. V. Balduf. (No. 2894.) Pp. 95+4 plates. (Washington, D.C. : Government Printing Office.)

Spisy Lékařské Fakulty Masarykovy University (Publications de la Faculté de Médecine), Brno. Svazek 11, Spis 109-114. Pp. iii+18+26+76+46+42+158. (Brno : A. Píša.) 40 Kč.

CATALOGUES

The Nickel Bulletin. Vol. 5, No. 6, June. Pp. 121-144. (London : The Mond Nickel Co., Ltd.)

Ornithology. (New Series, No. 28.) Pp. 56. (London : Wheldon and Wesley, Ltd.)

Books relating to America. (Catalogue 560.) Pp. 57. (London : Francis Edwards, Ltd.)

Astronomie. (Catalogue No. 188.) Pp. 160. (Paris : Hermann et Cie.

SATURDAY, JULY 16, 1932

CONTENTS

Scientific Leadership in Industry

IN the absence of adequate leadership, science, whether in its broadest aspect or in its narrow technical sense, will never occupy its rightful place in industry. Industry in Great Britain has suffered too much in the past from administrators whose deficiency in regard to a scientific outlook has rendered them incapable of maintaining an adequate scientific staff or of accepting an adequate and sustained research programme as a fixed charge comparable with insurance, depreciation or obsolescence, and incorporating its results in industrial practice.

Not the least important part of the plan which science could evolve would be the provision made for training administrators and leaders for industry and for the State, who would be capable of assessing those scientific factors which are involved to-day in almost every industrial, political or social question of the first importance. Under modern conditions, technical and scientific training is a *sine qua non* of competent leadership whether in industry or in the State, and the absence of adequate planning on scientific lines to-day is largely the result of the dearth of administrators who possess a first-hand experience of scientific technique; this, again, is partly due to a by no means negligible policy of deliberately excluding the scientific worker as such from important administrative positions.

It is difficult to assess the responsibility of the absence of scientific leadership for many of the grave problems confronting society. Under the conditions of modern civilisation, the community in general and not industry alone is dependent upon pure and applied science for its continued progress and prosperity. Under the influence of modern scientific discoveries and their applications in many directions other than industry, the whole basis of society is rapidly becoming scientific, and to an increasing extent the problems which confront the national administrator, whether judiciary or executive, involve factors which require scientific knowledge for their solution.

The Industrial Parliament visualised by Capt. Harold Macmillan, M.P., is an indication of the extent to which the changed conditions of the modern State are bringing us to consider the desirability of re-orientating representation on the basis of functional groups in order to link up knowledge and power more effectively in the service of the State and the general interest. Few aspects of civil life, for example, illustrate more aptly the hiatus between knowledge

and action than the field of transport. Whether we consider road transport, the railways, shipping, or aviation, the facilities which exist to-day are the outcome of scientific discoveries and their application, and the problems they present to society are in the main due to the absence of scientific organisation and control, and consequent development along haphazard lines ruinously expensive to the community as a whole.

In spite of the warning given by the recent Royal Commission on Transport about the absence of vision in such matters and its demonstration of the way in which ignorance and prejudice can bind burdens on the backs of posterity, as with railway development last century, neither in respect of the electrification of suburban services nor in the diversion of heavy goods traffic from the road to rail have any adequate steps been taken to give effect to the recommendations of the Commission, although both these recommendations should encourage employment and the recovery of the railways from their difficult position. In the absence of a more scientific policy, it is still common for a heavy goods lorry to do damage to a road in a few hours amounting to several times the combined value of the lorry and its load.

In other fields we have a number of problems created by industrial wastes. River pollution is becoming increasingly serious as fresh areas of the country are industrialised or the scale of industry increases. The beet sugar industry and the dairying industry provide two recent examples and also illustrate the assistance which scientific research can give in preventing or minimising the nuisance.

Again, the introduction of oil fuel for steamships immediately created a problem of waste-fuel disposal, and the layman could not have been expected to predict the serious consequences to marine and bird life and to many of our coastal resorts of a policy of dumping waste oil at sea. As in problems of atmospheric pollution, the solution lies almost entirely in the application of scientific methods of prevention and control, and in securing support for a scientific policy designed for the general advantage.

These and numerous similar problems have arisen through society using the results of scientific discoveries unguided by scientific and unprejudiced investigation of their reactions on the life of the community. Many such problems need not have become acute had an elementary amount of such foresight and scientific investigation been exercised in the early stages of the development of scientific discoveries, before the creation of vested interests or the growth of those local prejudices which generally hinder so strongly the development of a rational plan.

There are other wide fields in which the contribution of the scientific worker to the welfare of society is equally important and essential. Notably this is true in regard to food supply, where science is responsible not merely for protecting society against adulteration and for securing the purity of all kinds of foodstuffs, but also for the introduction of fertilisers giving higher yields per acre, for breeding new varieties which enable the zone of profitable cultivation to be extended, and for improved agricultural machinery and methods of cultivating and draining the soil. In addition, scientific research is urgently needed not only in the development and application of new insecticides and fungicides for the prevention or control of diseases or pests in the field, but also to an increasing extent to protect the harvested crops from damage by insect life, fungi, or moulds during storage. The colossal losses caused by insects and moulds to such products as cocoa, tobacco, dried fruit, grain, etc., in storage are as yet largely unappreciated by the public in Great Britain, in spite of the importance of storage space to a country which is so largely dependent upon imported foodstuffs.

In another but related direction, scientific workers are conducting investigations into the changes which occur in fresh fruit, meat, and fish in low-temperature storage and transport which have already assisted in improving the market condition of fruit, in minimising wastage during long voyages from overseas, and in improving the handling and transport of white fish so that a larger proportion of the catch can now be landed and marketed fresh than was formerly possible in half the time. The importance of such work in establishing on a firm basis the struggling fishing industry of Great Britain is obvious, apart from its national and social aspect.

Investigations of this type, closely related as they are to the welfare of society, are frequently long-range investigations requiring close co-operation between a number of classes of scientific workers. Only administration capable of taking a long-range and scientific point of view is competent to secure the necessary continuity or co-ordination, and in few fields is definite planning more important. Problems of food production and preservation should be taken out of the arena of political prejudices and debate into an atmosphere of impartial scientific examination.

Bacteriological Laboratories and Methods

Medical Research Council. A System of Bacteriology in relation to Medicine. Vol. 9. By J. A. Arkwright, S. L. Baker, M. M. Barratt, S. P. Bedson, J. C. Broom, H. C. Brown, H. H. Dale, P. Fildes, A. Fleming, A. D. Gardner, A. T. Glenny, J. Gordon, F. C. Happold, E. Hindle, B. C. J. G. Knight, J. C. G. Ledingham, R. J. Ludford, J. McIntosh, J. W. McLeod, P. G. Marshall, E. G. D. Murray, L. W. Proger, Wilson Smith, R. H. Stoughton, R. L. Vollum, L. E. H. Whitby, S. S. Zilva. Pp. 364. (London: H.M. Stationery Office, 1931.) 21*s*. net.

THE final volume of this work will be a boon to laboratory workers, and we welcome this plan of collecting in one volume the important laboratory methods, and congratulate both the writers and the editors on the very judicial selection they have made of the almost innumerable methods and variation of methods which are now employed in different laboratories.

Chap. i., dealing with design of bacteriological laboratories, is full of valuable suggestions, but, to the majority of bacteriologists, the plans are what we might dream of, only to waken and find they are not in the world of reality for us, and perhaps even be glad of that. We think it would have been better to have chosen something simpler, so as to give us an idea of what would be efficient and yet within the region of possibility from the not over-burdened exchequers of most universities and medical schools. The same may be said of the animal houses in Chap. xviii.

Chaps. ii. and iii. are excellent; but on page 40 the heading "Van Gieson's Stain" is surely wrong. Only the latter part is Van Gieson, and this is clear from number 5 under "Method" on the same page.

In Chap. iii., good though it is, there is the tendency to over-elaboration and the recommendation of methods which, under ordinary conditions, are impossible of attainment. Thus on page 63, to get blood serum, we have to go to the slaughter-house, reflect the skin from the neck of the animal, and so on. We may have been unfortunate, but we have never met the slaughterman who will allow us to spend the necessary time on such an operation, and we think such precautions are unnecessary. In this chapter it would have been valuable to have given some indication of simple methods of preparing culture media—methods which might be used by men who are working in the tropics and to whom a laboratory is not available. The elaboration in this chapter makes difficult what can be easily undertaken in any ordinary kitchen.

Chap. iv. deals very clearly with the determination of hydrogen ion concentration, and Chaps. v., vi., and vii. give valuable hints, and all that is necessary, on special cultivation methods and the isolation of single bacterial cells.

Many of the points discussed in Chaps. viii. and ix. are not found in ordinary textbooks of bacteriology, and should prove of great value, especially to the less experienced workers; but even the more senior ones will find valuable hints which may bring about improvements in their own methods. Chap. x., on viruses, collects the work which has appeared in various journals. Chaps. xii. and xiii. contain matters of great interest, and are well written. Their practical application is perhaps somewhat limited at present, but this, in our opinion, does not detract from their value.

Dr. Fildes's experience in serological investigations, and that of Dr. Glenny on toxins and antitoxins, would lead one to expect chapters of very practical value, and this expectation will be realised by those who read their two valuable communications in Chaps. xiv. and xv. The same can be said of Chap. xvi., the joint work of McIntosh and Dale.

Chap. xvii. will be welcomed by all heads of laboratories. It contains an immense amount of information of practical value, and gives details about which we venture to say most of our workers are profoundly ignorant, and which should be known to all. The methods may be too elaborate to be carried out in a laboratory the staff of which is very limited, and the apparatus too expensive; but from the mass of information given it will be possible to obtain a great deal which will be applicable and which must prove very helpful.

In Chap. xviii., Dr. Arkwright has summed up very well the methods by which variants are produced, and this should clear up a good deal of confused work on this subject.

Vitamin deficiency, electric charges, and the effects of ultra-violet rays, are briefly dealt with in Chaps. xix., xx., and xxi.

In Chap. xxii. we have a description of the Rideal-Walker test and the Chick-Martin tests for estimating the power of disinfectants. The authors state that there are so many factors concerned in this testing that the value of the disinfectant can only be judged from experiments in which the precise conditions under which it is to be employed are closely followed. It seems to us rather a serious omission that no reference is made to the fact that an established coefficient for

B. typhosus may be entirely different from the coefficient for another organism, for example, the streptococcus; or that one disinfectant useful for the destruction of certain bacteria is practically useless in the same dilution for others.

This volume contains the general index for the whole work. We welcome this index very much.

J. M. BEATTIE.

Theory of Algebraic Numbers

Foundations of the Theory of Algebraic Numbers. By Prof. Harris Hancock. Vol. 1: *Introduction to the General Theory.* (Published with the aid of the Charles Phelps Taft Memorial Fund, University of Cincinnati.) Pp. xxvii + 602. (New York: The Macmillan Co., 1931.) 8 dollars.

THIS is the first volume of Prof. Hancock's work and is intended as an introduction to the second volume. Its size shows that he is engaged in no light task. His object is to help in making the theory of algebraic numbers more accessible, more attractive, and less difficult. He obviously has in mind the English-speaking student, or at any rate those for whom German is a source of difficulty. For these, he has undoubtedly made more accessible and more easily readable the difficult theories of Dedekind and Kronecker, as well as the more elementary topics such as algebraic integers, quadratic and cubic fields, an introductory account of ideals, Hilbert's norm residue symbol, the law of quadratic reciprocity, and applications to Fermat's last theorem. The beginner will find much to interest him, as many of the chapters are self-contained and will be useful in supplementing a course of lectures.

The author also states that the theory of algebraic numbers is presented here from a heuristic point of view with the hope that through this method of treatment the innate relation of the general number theory to the function theory, algebra, algebraic (Abelian) integrals, and other branches of mathematics will be further developed, and eventually generalised into a united arithmetised entity, one contributing to the advancement of the other. But I think the author's hope will not be fulfilled, and that, in fact, he has missed an obvious opportunity of increasing considerably the value and usefulness of the present volume. The most important developments in the arithmetical theory of algebraic numbers during the present century have arisen from its association with the theory of groups and the application of this theory to the enunciation and proof of arithmetical theorems. Perhaps Hilbert was the first to emphasise the great arithmetical importance of expressing the properties of an algebraic field by means of its Galois group. It is only about five years ago that Artin showed that the general law of reciprocity (quadratic, cubic, etc.) in any field was most simply and beautifully stated as an isomorphism between the group of the class of ideals in the given field and the Galois group of an appropriate Abelian field.

The ambitious student who means to go deeply into the subject of algebraic numbers—and naturally it is an ambitious student who will contemplate mastering two large volumes—finds no reference whatever to groups. In fact, it seems as if the author made every endeavour to avoid using the language or methods of group theory. Thus in his chapter on algebraic fields of rationality containing some of the Galois theory, where nowadays one would have considered the notion of a group almost indispensable, he speaks of normal realms (that is, fields) and their divisors, but never mentions groups (except with its non-technical meaning) or subgroups or indices. Again, in dealing with classes of ideals, there is no mention that the classes form a group (an Abelian group, of course), a fact of vital importance in advanced work, which would enable him to simplify some proofs. Undoubtedly an introductory chapter on Abelian groups, and its application whenever possible, would have been very desirable and added considerably to the value of this volume.

L. J. MORDELL.

Towards Unity

The New World-Order. Essays arranged and edited by F. S. Marvin. (The Unity Series, 9.) Pp. vi + 188. (London: Oxford University Press, 1932.) 8*s*. 6*d*. net.

EVENTS of the post-War period are forcibly and unmistakably driving home the lesson that the future welfare of the human race is vitally dependent upon world co-operation. The days of self-sufficient nationalism, of splendid isolation, of Monroe doctrines, are clearly numbered, and it is widely felt that the more quickly such venerable creeds are abandoned the brighter will become the prospect for civilisation at large. How soon events will force the political unity that, in some form or other, appears inevitable, it would be rash to prophesy; but if the process of unification is to succeed, it can only be upon a previous basis of intellectual sympathy and understanding. It is in the intense realisation of this cardinal fact that Prof. Marvin and his fellow-thinkers are striving

to establish a wider outlook among the educated classes; and the signs indicate that they are meeting with an encouraging response—even in the most conservative quarters. Personal contact between scholars of different countries is so sure a method of breaking down the barriers of ignorance and prejudice that the present difficulties of foreign travel are to be deplored; but such books as this and the previous volumes of the "Unity Series" show what might be done by the printed word if sufficient enthusiasm—and funds—were available.

The present book is based upon lectures delivered at the two Unity History schools held at Danzig (1929) and Stockholm (1931) respectively, the special emphasis at both meetings being laid upon the growth of international co-operation. As Prof. Marvin justly observes, the fundamental law of human unity is best expressed in science, "because it has sprung from experiences common to all men and been elaborated as an articulate and marvellous system to which all civilisations have contributed"; and since momentous events have happened in science in the last few years, two scientific essays by Prof. Dingle hold pride of place in this collection. They are entitled "The Atom" and "The Universe", and are written with Prof. Dingle's accustomed skill and lucidity; their infusion with the author's philosophical views is just sufficient to add zest to the themes without deflecting attention from the facts. The balance of the book is preserved by essays upon English literature, Swedish architecture, international law and finance, economic success and failure, contemporary education, race problems in industry and culture, and the present position in biology. All are provocative of thought, and if the reviewer found Prof. Marvin's essay on contemporary education the most stimulating and attractive, the general level is so uniformly high that, among a dozen readers, there would doubtless be a dozen different orders of preference. We may perhaps mention that anyone who wishes to have details concerning the Unity movement may obtain them from Mrs. Innes, 29 High Oaks Road, Welwyn Garden City, Hertfordshire.

E. J. H.

Physics in Physiology

Groundwork of Biophysics. By Dr. G. M. Wishart. Pp. vii + 344. (London: G. Bell and Sons, Ltd., 1931.) 12*s.* 6*d.* net.

EVERYONE who teaches physiology will sympathise with Dr. Wishart in the experience which he has evidently had to induce him to write this book. The great majority of those who come to be taught physiology have had instruction in physics, but having also passed an examination in the subject have laid aside the burden of all that that examination imposed on them. If only this were not so and their training in physics had formed in them the habit of thinking about the world around them as such training should, they would find their study of physiology easier and more fruitful.

This work is written to supply what such students have failed to retain or omitted to acquire. But it is clearly not intended to be an introduction to the study of physiology. The reader is supposed to know what is meant by such things as reflex action and the respiratory quotient, that the excitation wave of the heart begins at the sino-auricular node, that the cells of the pancreas at rest are packed with granules, and that its secretion is inhibited by atropine. He is supposed, in fact, to have been introduced to physiology and to have discovered that he has to go back to what he thought his examination had entitled him to discard. Accordingly he is taken again over the gas laws, the structure of the atom, the law of mass action and the physical principles underlying the methods employed in the investigation of selected problems in physiology.

The question may arise, whether this plan of work is the ideal one, but if it is found in experience to give good results, if students are induced by these means to study physiology as, for example, Bayliss gave them the opportunity of doing in his "Principles", no one need quarrel over this. There may be those who still regret what they regarded as the dismemberment of physiology, when biochemistry began to be treated as a separate subject. Some of them may be dismayed at the prospect of further dissection leading to the severance of biophysics also as a distinct study. But that is not imminent. There is much in this book that the biochemists are concerned with, and there are, on the other hand, certain things that require physical treatment, the hydrodynamics of the circulation for example, which are left for the teacher of physiology to deal with. It is clearly meant to strengthen his hands, not to restrict his province.

There are chapters in the book in which the students to whom it is presumably addressed, those who failed to apprehend the principles which their instructors in physics and chemistry expounded to them, might be grateful to Dr. Wishart if he had departed, as in other places he has, from

the letter of traditional methods of exposition, methods which must from his premises be sometimes at least unsuccessful. But that the book can and should be helpful there is no doubt; it would be still more helpful if all parts equally were treated with the same freshness and originality of sympathetic exposition.

Short Reviews

Cambridge Excavations in Minorca. Trapucó. Part I. By Dr. Margaret A. Murray. With Chapters by Dr. Edith M. Guest, Dr. C. Ainsworth Mitchell and T. J. Ward. Pp. 50 + 52 plates. (London: Bernard Quaritch, Ltd., 1932.) 12*s*. 6*d*. net.

IN recent years a good deal of attention has been paid by prehistorians to the Balearic Islands, mainly in the hope of finding evidence of maritime trade between Spain, Sicily, and the south of France and the spread of culture between these centres during the copper age, but partly because these islands contain in considerable numbers certain monuments of large unworked stones, which, though unique, bear some resemblance to the megalithic monuments found elsewhere near the coasts of western and northern Europe. The most striking of these monuments are *talyots* and *taulas*, but whereas the former, circular buildings of rough masonry, are found both in Majorca and Minorca, the *taulas* occur only in the latter island.

It was to examine these monuments, and, if possible, to ascertain their age and purpose, that an expedition was sent out to Minorca by the Cambridge Museum of Ethnology. This expedition, which was under the command of Dr. Margaret Murray, carried out most careful excavations, found an abundance of pottery and other objects, which are attributed to the bronze and early iron ages, and took careful measurements of the *taulas* and their surroundings. While the expedition scarcely succeeded in discovering the purpose for which these great T-shaped monuments were erected, though they are concluded to have been objects of worship, it has finally disposed of the theory tentatively advanced by Cartailhac, that they were the central pillars of domestic structures.

The book is well got up, with numerous plates, giving views of the monuments and drawings of the pot-forms, so that, if the expedition has not wholly succeeded in solving all the problems involved, it has provided for archæologists a series of pottery extending over more than a millennium.

H. J. E. P.

Growing Up in New Guinea: a Comparative Study of Primitive Education. By Margaret Mead. Pp. xi + 285 + 16 plates. (London: George Routledge and Sons, Ltd., 1931.) 12*s*. 6*d*. net.

THIS is the second of a series of studies dealing with childhood and adolescence among relatively primitive peoples, undertaken by Dr. Margaret Mead for the purpose of investigating the original nature of the child in the light of the effect of varying types of environment and education. She has already published a volume on the adolescent of Samoa. Here she is concerned with the childhood and youth of the Manus, a sea-dwelling people of the Admiralty Islands. Each of a total of eighty-seven children was studied in detail, inheritance, family background, physical and mental character, and so forth being noted. The method of study also entailed an investigation of the social structure of the village, the system of marriage and relationship, and the economic conditions. The results of these latter investigations are reported in the body of the book only in so far as they bear on the main problem; but further information is given in appendices.

Dr. Mead's record is of the greatest interest, especially as the life of the adult, which is lived in conditions almost puritanical in their harsh rigidity, is in striking contrast to the licence of childhood and among the boys in adolescence. Children are instructed early in respect for property; but beyond that they enjoy absolute freedom, and exhibit a lack of subordination to their parents, especially the indulgent father, which appears to admit of no preparation for the complete subjection to their elders to which they must submit when the girl attains adolescence and the boy marries. It is evident, however, that the early period of apparent licence has in reality been a term of rigorous, if imperceptible, instruction by the force of society. Both sexes have already absorbed innumerable taboos which are obeyed as a second nature. Both in respect of the main problem, and incidentally as a record of a somewhat unusual type of social and economic organisation, Dr. Mead's book is highly instructive.

Tabulæ Biologicæ Periodicæ. Herausgegeben von C. Oppenheimer und L. Pincussen. Band 1 (= *Tabulæ Biologicæ*, Band 7.) Nr. 1. Pp. iii + 144. Nr. 2. Pp. 145-240. (Berlin: W. Junk, 1931.) Band 7 (4 Hefte), 55*s*.

THE first six volumes of "Tabulæ Biologicæ" have already been noticed in our columns. The seventh, of which the first three parts have been received, gives vol. 1 of "Tabulæ Biologicæ Periodicæ". The objects of this journal are to continue the collation of biological data recently published and to substitute corrected figures, based on more accurate estimations, for those already given in previous volumes. The principal data in the new numbers are as follow: series of figures concerning different aspects of photochemical reactions, chemical, physical, and spectrographic data of hæmoglobin and chlorophyll and their derivatives, a very useful table of the vitamin content of foodstuffs, a lengthy list of plant chromosome numbers (occupying more than a hundred pages), tables of the iodine content of vegetable and animal foods, as well as data referring to phonetics, and a number of other miscellaneous constants of biological interest, such as the physico-chemical constants of blood and tissue fluids. The collection of these data is of great value to all biologists. The usefulness of the parts, however, would be greatly enhanced if it were

possible to publish a detailed cumulative index with each. The volume may be recommended to all biochemists, physiologists, and biologists as a useful work of reference.

A Book of General Science. By M. J. Hilton. (Macmillan's Canadian School Series.) Pp. xiv + 399. (Toronto: The Macmillan Co. of Canada, Ltd.; London: Macmillan and Co., Ltd., 1931.) 7*s.* 6*d.* net.

IN this book the subject of general science is dealt with in an interesting way, and is well illustrated. Commencing with a chapter on systems and standards of measurement, the book deals in turn with air, water, life, energy, the earth's crust, and the solar system. Each chapter contains descriptions of experiments; and the necessary apparatus required for the experiments is described, with the method of procedure, what to observe, and an explanation of what has taken place. The atmosphere and the methods employed to measure its pressure lead to the subject of elementary meteorology. A chapter is devoted to the uses to which man puts the properties of air. More space might have been given with advantage to the sections dealing with biology and energy. The book is, however, well worth the attention of teachers and students of general science.

An Introduction to Egyptian Religion: an Account of Religion in Egypt during the Eighteenth Dynasty. By A. W. Shorter. Pp. xv + 139 + 8 plates. (London: Kegan Paul and Co., Ltd., 1931.) 8*s.* 6*d.* net.

THIS brief account of the religion of ancient Egypt in the eighteenth and early nineteenth dynasties is intended both for the general reader and for those who are entering on the study of Egyptology. During the last twenty years, our knowledge of Egyptian religion has been much amplified by the labours of the archæologist, and a textbook such as this, which incorporates the new material, was greatly needed. Mr. Shorter has based the whole of his descriptive matter on the monuments, so that the reader unversed in the technique of Egyptian studies may learn how our knowledge is acquired. Akhenaton and Aton worship are not unduly emphasised, as so often happens in the discussion of eighteenth dynasty religious beliefs, though their significance is appreciated to the full. The account of Queen Hatshepsut is, in its way, the best thing in the book.

Colloid Aspects of Food Chemistry and Technology. By Dr. William Clayton. Pp. viii + 571 + 6 plates. (London: J. and A. Churchill, 1932.) 36*s.*

WE start life as a quivering lump of jelly, and most of our foodstuffs are colloids. Food chemistry and food technology have passed beyond the stage of mere analysis into a field of science which engages all the important physico-chemical problems of colloids. Hence the need for a textbook which summarises the voluminous and scattered literature. Such problems as the staling of bread, the foaming of milk, the homogenisation of cheese, the sandiness in ice-cream, the froth on beer, the fining of wine, the clarification of water, to name but a few, all involve colloidal chemistry. Such a work will soon be found invaluable in the food laboratory, and the author's reputation ensures its thoroughness.

In addition to copious references in the text, a classified biography of nearly a hundred pages, containing more than two thousand references, is included, and a valuable feature is a glossary of the new terms which have crept into the subject.

Vorlesungen über vergleichende Anatomie. Von Prof. Otto Bütschli. Lieferung 5: *Leibeshöhle.* Überarbeitet und herausgegeben von C. Hamburger. Pp. iv + 381-490. (Berlin: Julius Springer, 1931.) 16·80 gold marks.

THIS section of Bütschli's textbook of comparative anatomy, commenced by Blochmann and completed by Hamburger of Heidelberg, deals with the body cavities. One half of the text is devoted to the invertebrates and one half to the chordates. The development of the cœlom, mesenteries, pericardio-peritoneal septum, and diaphragm is traced with the aid of simple diagrams. The abdominal pore is traced through cyclostomes, fishes, and birds. The facts of embryology are incorporated in the text with clarity. The absence of theorising and the excellence of the diagrams are to be commended.

Mechanics for Beginners. By F. Barraclough and Dr. E. J. Holmyard. (Dent's Modern Science Series.) Pp. viii + 214 + 8 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1931.) 2*s.* 6*d.*

THE particularly difficult problem of making the principles of mechanics interesting to the beginner, without at the same time sacrificing scientific accuracy, is very successfully accomplished in the well-known style of which Dr. Holmyard may be said to be the pioneer. The result, with its special emphasis on the historical development of the science, is as much a fascinating reader as a textbook. N. M. B.

Cicatrisation et régénération. Par Prof. Jacques Millot. (Collection Armand Colin: Section de biologie, No. 141.) Pp. 204. (Paris: Armand Colin, 1931.) 10·50 francs.

A BRIEF account of the present views of wound-healing and regeneration of parts in the animal kingdom, with special regard to the more recent experimental methods in the lower animal forms. The physiological factors involved are analysed, and there is an interesting account of the corresponding compensatory mechanism in plants.

Hunting Insects in the South Seas. By Evelyn Cheesman. Pp. xi + 243 + 8 plates. (London: Philip Allan and Co., Ltd., 1932.) 10*s.* 6*d.* net.

MISS CHEESMAN has travelled widely among the Pacific islands and is a keen observer of insect life. In this, her latest book, she gives a very readable and interesting popular account of insect hunting and other experiences in Tahiti, the Marquesas Islands, and the New Hebrides.

The Enclosure of the Zuider Zee

By Dr. Brysson Cunningham

May 28 last will always be a notable date in the annals of the Netherlands. On that day, in the presence of distinguished government officials, the crucial deposit of clay was made which finally and entirely cut off the waters of the Zuider Zee from any intermingling with the outer sea. The means of severance, it is true, is but a narrow earthen embankment, stretching like a taut cord or strip of ribbon, for a length of 18½ miles, from the eastern extremity of the former island of Wieringen to the Friesian coast, but it suffices to create an impassable barrier, intersected only by three locks for purposes of navigation and by two groups of sluices for surplus water discharge, and it marks the commencement of a distinctly new regimen for the impounded area.

Hitherto, this vast expanse of nearly a million acres of water has been an arm of the sea; at present, it is an inland lake, the greater part of which is destined to be pumped dry and converted into agricultural holdings, while the residue will constitute a reservoir for fresh water, instead of salt water, to be utilised, apart from navigation, as a source of supply for irrigation and farming. In the ultimate result, the transformation will mean an increase of seven per cent in the area of the whole country and of ten per cent in the area of arable land. Relatively, it is as if Holland were enlarged by the addition of a province roughly equivalent in size to Kent or Essex or Sussex.

In Nature of Sept. 21, 1929, following a visit to the site of the works, I gave an outline of the scope and probable effects of this tremendous project, which has, for several centuries past, occupied the minds of the Dutch people and exercised the ingenuity of their engineers. Living, as they do, within a territory of restricted extent, much of it lying below sea-level and subject to tidal inundation, they have been compelled, at much trouble and expense, to win from the sea such tracts as were possible in order to find scope for the natural expansion of the population and their industrial activities. According to statistics published in 1924, there had then been an increment of about 250,000 acres, gained since the year 1846. Including the exploitation of land previously considered as waste, the total increase in arable land during the last century has been rather more than a million acres, equivalent to a rate of 10,000 acres a year, but against this must be set off the loss due to building and engineering operations, latterly at the rate of about 6000 acres a year. This leaves a

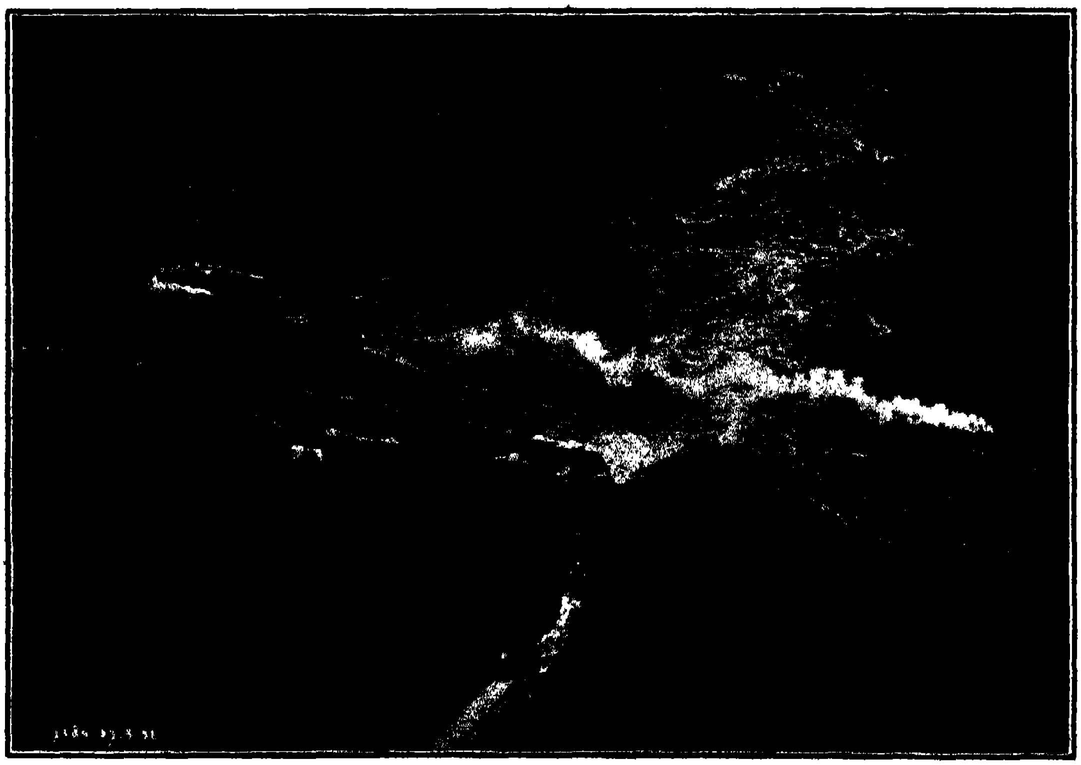

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Fig. 1.—The concluding stage in the enclosure of the Zuider Zee, showing plant in operation.

net annual gain of 4000 acres per annum; but the population is growing fast, and there is at the present time a distinct shortage of arable land.

The acquisition of so large an area as that covered by the Zuider Zee naturally involved a multitude of complex problems, so that it was only after protracted consideration and many financial and legislative delays, inseparable from an undertaking of such magnitude, that the work was actually commenced in 1920. It has therefore been in progress over a period of twelve years. In accordance with the plan prepared by the late Dr. C. Lely, it involved the construction of a main dyke, or embankment, which, starting from the little village of Van Ewijcksluis on the eastern coast of the province of North Holland, extends across a deep strait of 1½ miles to the western side of the island of Wieringen, to be resumed at Den Oever at the eastern extremity of the same island, and thence, apart from a slight curvature at the eastern end, to stretch in a straight line eastwards as far as the village of Zurig on the coast of the province of Friesland. South of the main dyke, or enclosing dam, a series of four separate areas or 'polders' with an aggregate content of about 550,000 acres, is to be reclaimed by pumping out the water into a central lake of about 270,000 acres, provisionally designated the Yssel Lake and designed to receive the discharge of the rivers Yssel, Zwartewater, and Vecht from the mainland. The first of these polders has, in fact, already been reclaimed and the progress made thereon will be referred to later. For the moment, attention is directed to the concluding stages of the work in connexion with the main dyke, which, with the four polders, is shown in the map accompanying my article in NATURE for Sept. 21, 1929.

At the time of writing the above article, the island of Wieringen had already been joined up to the mainland and a substantial roadway formed across the Amstel Diep. The work was proceeding in the main dyke from both extremities, namely, eastwards from Den Oever and westwards from the Friesian coast across the shallows of Makkummerwaard to the site of the navigation locks at Kornwerderzand, a distance of 2½ miles. Approximately half-way between the Kornwerderzand and Den Oever, lies another shoal area, called the Breezand. Advantage was taken of its existence to commence, in 1929, a detached mid-sea section, which has been extended eastwards and westwards to link up with the coastal sections. The intervening spaces were crossed by two deep 'guts' or channels, the Vlieter on the west and the Middelgronden on the east, in which the depth of water increased to as much as 10 metres. These channels were first treated with shallow deposits of material to form 'sill dams', reducing the depth of water over them to more convenient limits. The material consisted of a layer of boulder clay protected by a covering of 'mattresses' of brushwood, weighted down in position by means of heavy stone fragments and secured by stakes driven into the ground. The mattresses were arranged to extend appreciably beyond the limits of the main dyke, in order to ensure protection from scour. These sills were completed in 1930.

When, a year later, preparations were made to proceed with the formation of the dam itself on these sills, it was found that the brushwood, while maintaining its position, had suffered a good deal

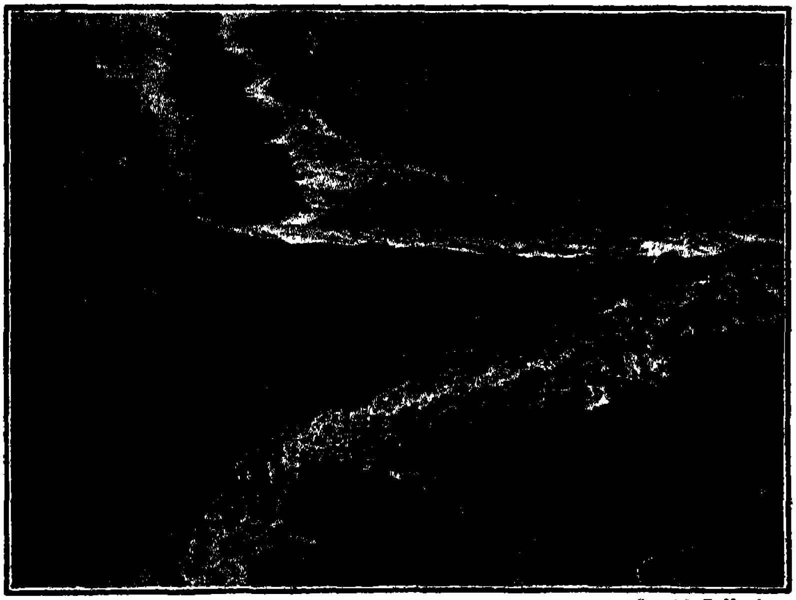

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FIG. 2.—The last gap in the Vlieter channel.

from the attacks of marine borers, and that considerable corrosion of the galvanised binding wire had taken place. The sill on the Middelgronden had deteriorated to a greater extent than that on the Vlieter, and, accordingly, first attention was given to the execution of the main structure across the former. It was completed in November 1931. The work carried out during the first half of the current year has been the final closing length across the Vlieter.

The method of forming the main dyke consisted in first depositing a substantial body of boulder clay to form a nucleus and a frontal barrier. Behind this was discharged a mass of sand (dredged within the limits of the Zuider Zee and transported to the site), which was covered in turn by a layer of clay, or boulder clay, the latter being a specially tough variety of glacial origin, containing boulders, found in the floor of the Zuider Zee in various places, as well as on the island of Wieringen and on the south coast of the province of Friesland. It has proved eminently suitable for resisting the scouring action of currents, and its qualities in this respect were

fully tested during the period of concentrated flow while the tidal water was passing in and out of the gradually contracting gap, as can be well seen from the photographs in Figs. 1 and 2 taken the day before the final closure was made. I had an opportunity myself of witnessing the concluding stage of the construction of the dam flanking the new north-west polder, and was much impressed by the resistive capacity of the material. As a final covering, the exposed surface of the embankment is protected below the water-line by mattresses of brushwood, weighted with rip-rap, and above the water-line by a stone facing of basalt or limestone, brought from Germany.

A point of interest that requires mention is the effect of the constructional operations on the tidal conditions. It is stated that up to the end of 1929 (with the exception of a period in 1924 due to the closing of the Amstel Diep between the island of Wieringen and the mainland), there had been scarcely any changes in the tidal movement. Afterwards, as a result of the formation of the sills in the channels of Middelgronden and Vlieter, the velocity of flow across the line of the dam increased to a marked degree, reaching 3-3¼ ft. per second, while, at the same time, certain changes were manifesting themselves in the rise of the tide in the outer area, very perceptibly in the Texel Strait and less noticeably in the Vlie Strait. These changes will require further observation before they can be definitely evaluated, but they appear to be of the order of 6-12 inches, generally, in the Wadden Zee.

Concurrently with the construction of the main dyke, operations have been in hand for developing the new north-west polder (Wieringermeer) of 50,000 acres, which was reclaimed by the formation of an auxiliary dyke in advance of the main project. It was pumped out in 1930, the quantity of water discharged within a period of six months being more than 132,000 million gallons. The land, of course, had been covered with sea water for centuries and the soil was heavily charged with salt. The mean salinity ranged from ½ to 2 per cent, the variation being due to the proximity, in certain parts, of fresh-water outlets from land drainage systems. A surface soil chart is in course of preparation, for which purpose borings are being taken on every plot of 5 hectares to a depth of 1½ metres. The result of the investigation in regard to the first polder-section shows that the surface layer is of unequal thickness and consists mainly of sand, under which clay is often found, and, further, of a small percentage of clay and sandy clay with a small amount of peat. There appears, however, to be considerable dissimilarity of structure in different areas.

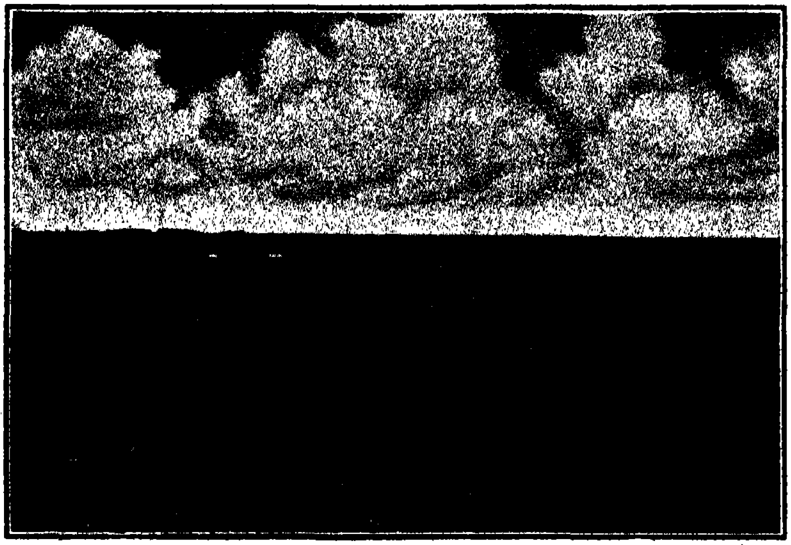

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FIG. 3.—Harvesting the first crop of rye on the Wieringermeer.

One of the earliest and most important problems to be solved before cultivation could be attempted was that of internal drainage. The first intention of providing a network of shallow trenches was abandoned, as it failed to drain the sub-soil sufficiently, or to remove the salt. Covered-in drains would have been preferred, but the cost was high, and, finally, recourse was had to a system of open trenches on a large scale. They have a depth of 60 cm. and are arranged at distances apart of 11 metres in clay areas and of 15 metres in sandy areas. In the spring of 1931, the sampling of soil showed that about 400 hectares of sandy ground in polder-section No. 1 was suitable for cultivation (Fig. 3), while the ground with a higher clay composition still retained an excess of salt. In the autumn, further tests were made, as a result of which, 1050 hectares were declared suitable for planting with cabbage, or sowing with winter barley and wheat, while 900 hectares were treated with a mixture of grass and clover seed to develop permanent pasturage.

The remarkable experiment of bringing the Zuider Zee into a state of agricultural productivity will be watched with the greatest interest, as its economic value to the inhabitants of the Netherlands is a matter of no little importance. In 1924, the outlay on the main dyke and the reclamation of the polders until the latter attain their full cultivable state was estimated at about thirty million pounds, to which interest over the unproductive period would add some fifteen millions, making a total of forty-five millions. The profits to be derived had, of course, to be evaluated on a more or less speculative basis, but they were put at a figure of fifty-two millions. In 1928, it was reported that actual costs to date had exceeded the estimates by some five millions, due to the rise in prices of public works, particularly dredging, and certain constructional difficulties, which could not have been foreseen. Since then, there have been

some reduction in prices, and if the favourable conditions continue, it is hoped to complete the undertaking without further excess and even with some reduction of the debit.

Everyone will hope that this enterprise of high courage and endeavour will be crowned with the success it deserves. Very great credit is due to its promoters and to the engineering staffs who have faced and overcome all the difficulties which have arisen from time to time. I am indebted to Dr. Ir. J. A. Ringers, director-general of the Rijkswaterstaat, for the photographs reproduced and the greater part of the information on which this article is based. For several years he was in charge of the operations, as director of the association of contracting companies expressly formed for the execution of the project, known as the Maatschappij tot Uitvoering van Zuiderzee-werken. On the Government side, mention should be made of the Zuiderzee Board, with Dr. H. Colijn at its head, and the office of the Zuiderzee works, to which Mr. V. J. P. de Blocq van Kuffeler is director-general.

Basic English *

ABOUT three centuries have now elapsed since three master minds—Descartes, Pascal, and Leibniz—espoused the cause of a *lingua franca*, and ingenious attempts are still being made to devise or construct a synthetic language for international use. The case for the adoption of an international *auxiliary* language (I.A.L.) is stronger now than it has ever been, but results have so far been disappointing. Though several of the projects that have been put forward might, with more or less modification, have proved satisfactory, practically none, with the exceptions of Volapük and Esperanto, has gone far beyond the threshold of the academy or the study. As Prof. Donnan has said, so far as numbers are concerned, Esperanto is the greatest and most successful linguistic experiment that the world has seen. The causes of failure are mainly psychological. Mankind is not ruled by reason, and the idea or ideal of an I.A.L. does not appeal to man's pleasurable emotions or to his primary instincts, except probably to that of pugnacity, for enthusiasts in this field have shown almost as little brotherly love to competitors as did rival religionists in days now happily past. Another obstacle has been the widespread fallacy that anything artificial is *ipso facto* inferior to its natural counterpart. However, the cause endures, and the latest apostle, Mr. C. K. Ogden, comes forward with a simplified form of English, called Basic, to compete, and peradventure to conquer, in the field of international linguistics.

The main features of Basic, which derives its name from the initial letters of the words, British, American, Scientific, International, Commercial, are : a very restricted vocabulary of nouns (600) ; the use of only sixteen or seventeen verbs, including come, get, give, go, keep, let, make, put, seem, and a few others ; the use of 150 adjectives and a number of prepositions, adverbs, pronouns, and conjunctions, but apparently no interjections. The grand total is 850 words, but further nouns can be created by adding the suffixes -er, -ed, and -ing to 300 of the primary nouns. Word-order is essentially the same as in good English, although the adverb is banished to the end of the sentence. Pronunciation is to be standardised by means of gramophone records, but spelling is not to be simplified or made phonetic.

Perusal of the Basic textbooks leads to the conclusion that simple conversations could be carried on with the above 850 words and simple derivatives, although in places the phraseology would appear strange, ambiguous, or prolix. Thus, a witch is " a woman with strange powers " ; a widow is " a woman not married again " (every *divorcée* who does not re-marry is thus conveniently made a widow !) ; and a baby is " a diminutive object ". We must not study or use Basic, but " go into " it and " make use of " it. If we are in difficulty, we must not ask but " make a request " for explanation ; we must " make dry " our eyes if we cry ; and " get off the ship " when we come to land. " Friday ", we are told, " is the day all the week's payments are made " ; and for dinner we are asked, " What sort of beef will you have, cooked in the oven or over the fire ? " (roast, or boiled, fried, or stewed !). Mercifully, we never " die ", we merely " take our last breath " or " go to our end ".

This simple but circuitous language would be useful to a foreigner wishing to learn something better than ' pidgin ' English ; it is easy to acquire and to use, and it would serve him as a good introduction to English proper ; but it seems certain that the 850 words, *plus* the simple derivatives of the primary nouns, would not suffice for any except very elementary purposes. It is true that provision is made for expanding the primary vocabulary to 1000 words by including in it 150 names of general utility, and further additions, for example, 12 international names, 12 (only) names of sciences, and other proper names are also permitted ; but would the foreigner remain content with these ? Would he not ask for more, in order to read English newspapers and literature, as well as to converse and correspond with educated Englishmen ? English-speaking peoples themselves would not find it easy to talk ' pure ' Basic ; they would be hard put to it to remember which nouns were in the vocabulary and which were not. For international use, it would be difficult to standardise this language, and the fact that it has a national basis would undoubtedly impede its adoption.

* " Basic English Applied (Science)." By C. K. Ogden. With specimen Translations in Chemistry, Physics, and Biology, by R. Michaelis. Pp. 88. " The Basic Traveller : and other Examples of Basic English." By L. W. Lockhart. Pp. 119. " The Basic Vocabulary : a Statistical Analysis with special reference to Substitution and Translation." By C. K. Ogden. Pp. 96. " The Basic Dictionary : being the 7500 most Useful Words with their Equivalents in Basic English ; for the Use of Translators, Teachers, and Students." By C. K. Ogden. Pp. xx + 106. " Debabelisation : with a Survey of Contemporary Opinion on the Problem of a Universal Language." By C. K. Ogden. Pp. 171. " Basic English : a General Introduction with Rules and Grammar." By C. K. Ogden. Pp. 95. (London : Kegan Paul and Co., Ltd., 1930–1932.) Each vol. 2*s*. 6*d*. net.

From the literary point of view, it is a relief to read that "although Basic is clear and precise at the level for which it is intended", it has no literary claims. It seems to discard most of the canons of good style, for example, to prefer the concrete to the abstract, and to use the single word in preference to the circumlocution. The author has little use for "the antic haverings of a pedantic pedestrianism in quest of Pure English"; so he allows us cheerfully to mix up 'shall' and 'will', to use noun-adjectives *ad lib.*, and to end a sentence with a preposition.

The fact that Basic has no literary pretensions and is yet recommended as the I.A.L. for science, suggests that its author has a poor opinion of the literary value of scientific writing. If so, he is not alone; but if present-day style in scientific writing is generally poor, it is at least preferable to that of Basic. A style that is both concise and precise is indispensable to good scientific writing, and the scientific author who uses two words where one would suffice, is as much a malefactor as the man who makes two blades grow where one grew before is a benefactor to his kind. Although Mr. Ogden realises that a much larger vocabulary is needed for science than for more mundane purposes, it seems certain that many more nouns would be required than he contemplates. As in other national languages, the resources of English are proving more and more inadequate to keep pace with the multiplication of new concepts, so that science would appear to need an I.A.L. possessing a vocabulary of constructed words that would allow of constant and regular expansion, rather than a language like Basic the chief aim of which is to restrict the vocabulary to the smallest possible number of words. What is sauce to the Kafir is not necessarily sauce to the chemist.

In "Basic English Applied (Science)", Basic versions are given of three scientific communications: a paper from the *Journal of the Chemical Society* on the analysis of light oils and motor spirits; a lecture on the mathematical problem of aerodynamics; a letter to NATURE (**123**, 601; 1929) on spectrographic analysis of animal tissues; and a few abstracts of patents taken from the *Nickel Bulletin*. Lack of space precludes a detailed appreciation of these efforts, and it must suffice to say that in the writer's opinion the translator has succeeded in making his translations generally intelligible, but that the 'wordiness', the frequent lack of precision, and the frequently curious phraseology all combine to make one hope that scientific English will never descend "to the level for which Basic is designed". The following are some examples in which Basic wording (given in italics) is held to be deficient: Desiccator—*drying vessel*; retort—*heating apparatus*; alloy—*mixed metal*; boiling—*at vapour temperature*; evolution —*development*; describe—*give details of*; distil—*give a distillation*; viscous-fluid flow—*motion in liquid or gaseous mediums*. The method has been developed quantitatively—*By an expansion of the method it is possible to get the amount of the elements present*. A detailed account of the work will be published shortly—*A detailed account of the work will be printed shortly*.

The somewhat unconventional ending to one paper, "*It was very kind of the Director of Fuel Research to let the writer put this paper into print*", prompts the present writer to sum up his conclusions as follows: *It was very kind of the Editor of* NATURE *to let the writer have these books and give his opinions of them; they are bright* (clever) *and interesting and in places they give amusement; but they do not give him strong belief* (convince him). *Though he is of the opinion that the new language* (old wine in a new vessel) *will be of use to men of other countries when they make a start to learn our language, he has the hope and makes the request to a Higher Being* (prays) *that it may at no time come into use for Letters or for Science. It might make better the language of trade; it is almost not possible to make it worse.*

In making this attempt at 'an attempt', the reviewer was surprised and perplexed not to find the word "Basic" in the 850-word vocabulary, either among the 400 "necessary names" or the 200 "common things". Is this an omen?

Obituary

PROF. ROLAND THAXTER

PROF. ROLAND THAXTER, of Harvard, died on April 22, at the age of seventy-three years. He was born at Newton, Mass., on Aug. 28, 1858, and graduated at Harvard University in 1882, proceeding to post-graduate work there until he was appointed mycologist at the Connecticut Experimental Station in 1888. Three years later he returned to Harvard as assistant professor of cryptogamic botany, becoming professor in 1901. He retired in 1919 with the title of emeritus professor, and acted as honorary curator of the Farlow Herbarium.

Such is the bare outline of the career of one whose work in mycology is classical. His first researches were on the rust *Gymnosporangium*, but he published an account of the entomogenous family Entomopthoreæ in 1888, which still remains one of the most important papers on the group. A few phytopathological reports appeared while he was at Connecticut, some of considerable interest. In 1890 he made his first contribution to our knowledge of the peculiar entomogenous fungi, the Laboulbeniaceæ, and it is with these that his name is chiefly associated, for from being almost unknown, they became, owing to Thaxter's enthusiasm, a group as well understood as any other and containing hundreds of genera and thousands of species.

Thaxter's method was to publish preliminary diagnoses of new genera and species and gather these together in monographs bearing the title "Contributions towards a Monograph of the Laboulbeniaceæ", which were illustrated with numerous plates of admirable drawings by the author. Part V. of the "Contributions" appeared this year, and he was busy preparing a sixth when he died. Some idea of the work entailed in the

description and figures may be gained from the fact that the five parts in all run to 1185 pages and 166 plates. Probably no mycologist, with the exception of Elias Fries, has ever been identified with a group to the extent that Thaxter was with the Laboulbeniaceæ. However, he did not restrict his observations to this fascinating group, but seemed to possess an almost unhuman *flair* for finding fungi which he himself called "new or peculiar", and described by him occasionally throughout his career. He was, moreover, the first to recognise the anomalous group Myxobacteriaceæ which have lately come into fashion.

Thaxter's association with Prof. W. G. Farlow at Harvard was an ideal one, and together they succeeded in building up a school of cryptogamic botany and herbarium which are without rival in any university. For a number of years Thaxter suffered from ill-health, but his letters were always cheerful, even when increasing trouble with cataract made it seem probable that he would be compelled to cease work. He was somewhat critical of some of the recent tendencies in applied mycology, but his criticisms were given from the fullness of his knowledge of the subject and not from a feeling of having been left behind.

In 1907, Thaxter succeeded Farlow as American editor of the *Annals of Botany*, Farlow having served since its beginning in 1887. His name was thus always prominently before British botanists. He received many distinctions; among others, he was a foreign member of the Linnean Society of London, honorary fellow of the Royal Society of Edinburgh, and honorary member of the British Mycological Society.

DR. CUTHBERT CHRISTY

NEWS has recently been received of the death on May 29, at sixty-eight years of age, of Dr. Cuthbert Christy, the well-known naturalist and explorer, who was engaged in scientific work for the Belgian Government in the Congo. It appears that, while in the Aka River region, he wounded a buffalo which turned and gored him, inflicting fatal injuries. He had for many years been collecting for the British Museum (Natural History), and his collections, notably those from Lakes Nyasa and Tanganyika, have proved to be of quite exceptional importance.

Dr. Christy was the son of Robert Christy of Chelmsford, and was educated at Scarborough and the University of Edinburgh, where he proceeded to take a medical degree and was appointed Mackenzie bursar in anatomy. His first travels abroad started in 1892, when for three years he travelled throughout a large part of South America and the West Indies. Some years later he was appointed Medical Officer of the 2nd Battalion West African Field Force in Northern Nigeria, and afterwards took on the duties of medical officer in India in the Bombay Plague Laboratory. In 1902 he served on the first Sleeping Sickness Commission in Africa, and at a later date was a member of the Liverpool School of Tropical Medicine Sleeping Sickness Expedition to the Congo, and of that organised by the Sudan Government.

Dr. Christy's intimate knowledge of native life in health and disease, and his explorations in many fields, are revealed to some extent in several published works and reports, among them being "Big Game and Pygmies", "Mosquitoes and Malaria", and "The Birds of San Domingo". He was chairman of the International Commission appointed by the League of Nations to inquire into the existence of slavery and forced labour in Liberia; and the recommendations of the Commission were accepted by the Council of the League and the Liberian Government.

Between 1903 and 1910, Dr. Christy visited Ceylon and various parts of East and West Africa, all the time collecting such specimens for the Natural History Museum as came his way. From 1911 until 1914 he was engaged in scientific exploration work in the Congo, and during this period he obtained many specimens for the Museum collections.

Among the mammals collected during this period were an important collection from the neighbourhood of Avakubi, in which Dr. Christy obtained two rats new to science and a dormouse which was named after him, *Graphiurus christyi*. He also obtained specimens of many rare West African forms in the same collection, thus adding considerably to our knowledge of the distribution of these species.

During the War, in spite of official duties, Dr. Christy still continued to collect, and sent home a very fine collection of fish from Mesopotamia. After the War he conducted two very important expeditions, one to Lake Nyasa and one to Lake Tanganyika, where he collected a great quantity and variety of fishes. These collections have proved to be some of the most important that have ever been received by the Natural History Museum, and the number of new species already described is very great; in one genus alone the species have been multiplied by six since Dr. Christy's collection has been worked out. The work in connexion with these collections is still continuing and many new forms doubtless remain to be described.

Medical science has lost a very able man in the death of Dr. Christy, and zoological science has lost one of its keenest collectors and most painstaking observers.

MR. L. G. SUTTON

THE death of Mr. Leonard Goodhart Sutton, in his sixty-ninth year, took place somewhat suddenly at his residence, "Hillside", Reading, on June 13. Mr. Sutton was a grandson of the founder, and at the time of his death senior partner, of the world-famous firm of Sutton and Sons. He was educated at Wellington College, and later went to the Royal Agricultural College, Cirencester, where he became particularly interested in the botany of grasses, of which group of plants he had a wide and accurate knowledge. After leaving Cirencester, Mr. Sutton spent two years in Germany, devoting himself to the study of the methods of seed production. On returning to England he entered the firm as a

partner, and ultimately settled down to development and extension of the floricultural side of the firm's activities, his outlook and experience being afterwards enlarged by visits to California and South Africa.

Mr. Sutton had a keen, refined sense of the æsthetic and cultural merits of flowers in general, and possessed an unerring intuition of the charm of old favourites and the floricultural possibility of new introductions to the garden, such as the South African *Nemesia strumosa* and allied species, which may be arranged to provide a glorious display of colour almost throughout the year. Belonging to the old school of plant breeders, Mr. Sutton paid special attention to the observation of small differences and the repeated selection of these in the evolution of improved forms. He was, however, fully alive to the value of a knowledge of Mendelian laws of inheritance in the practical improvement of garden plants. He wrote very little, but his unpretentious little volume—an extension of a lecture delivered before the Royal Horticultural Society—on garden annuals, is a charming introduction to the beauty, variety, and cultivation of this gay group of plants for which he had such an intense love.

Mr. Sutton took an ardent interest in educational affairs, and at the time of his death was president of the Council of the University of Reading; his inspiring presence and sound judgment will be greatly missed.

WE regret to announce the following deaths:

Dr. Bedford Pierce, past president of the Psychiatry Section of the Royal Society of Medicine, on July 8, aged seventy years.

Sir Richard Threlfall, G.B.E., F.R.S., chairman of the Fuel Research Board, on July 10, aged seventy years.

News and Views

Colloidal Fuel

TOWARDS the end of the War, when the demands for oil for naval purposes exceeded available supplies, efforts were made in America to make the oil go further by admixture of pulverised coal to give a blend called 'colloidal fuel'. Coal is appreciably heavier than oil, and it is obviously essential to prevent segregation of the components when blended. According to the American patent literature, stable solutions were obtained by suitably grinding the coal and by the incorporation of a stabilising 'fixateur', for example, a soap solution or a lime rosin grease. Great publicity was given at the time to this work, and the advantages of such blends were recognised. The coal-oil blend was heavier than water, could be stored under water, and was therefore 'safe' to store, while its calorific value per gallon exceeded that of oil. The lower price of coal reduced the cost of the unit of heat in the oil. In spite of these advantages, when oil again became freely available 'colloidal fuel' passed into the background. The subject was discussed in the House of Commons on July 5, and Mr. Foot, Secretary for Mines, referred to the experimental work which has been carried out by the Cunard Steamship Co., Ltd. This Company has continued investigating the possibility of blending coal with oil, and one of its liners, the *Scythia*, has just made the round trip between Liverpool and New York with one boiler fired solely by 'colloidal fuel' containing 40 per cent of coal.

ACCORDING to a report in the *Times* of July 6, the technical staff of the Cunard Company is entirely satisfied with the performance of the fuel. The burners gave no trouble, the ship's deck was free from grit, and the blend retained its stability. No details have been disclosed as to the mode of preparation, but it is claimed that the blend will retain its stability for three months. 'Colloidal fuel' is of obvious importance to European coal-producing countries, and the importance increases as coal tends to cheapen. Authorities agree that for ocean liners and naval vessels, oil fuel has such advantages over lump coal that even price loses its importance. When coal is pulverised, it acquires some of the advantages of a fluid, but a ship is scarcely the place to manufacture fuel. If a satisfactory blend can be made ashore and taken on board by pumping, the position will be greatly improved. Clearly the problem deserves the closest investigation, and the studies of the Cunard Company may be contrasted with the futility of a deputation of coalowners begging the Government to compel the Admiralty to burn coal instead of oil. Much oil is also being used in land installations, and the fuel should be equally applicable for these.

Professional and Technical Workers in the Civil Service

THE tradition that professional and scientific men should be passed over by authority when the personnel of Royal Commissions and other public inquiries are under consideration is well established and has frequently been the subject of comment in these columns. Recently, however, this attitude towards the expert has expressed itself in a new form. It happens that in the negotiating machinery which deals with economic questions concerning the civil service as a whole the existence of the expert has been recognised, in the constitution of the National Whitley Council, by the formal inclusion of the Institution of Professional Civil Servants as one of the three representative groups of staff associations. Recently, as is generally known, negotiations have been proceeding between the Government and the staff associations through the medium of the National Whitley Council regarding the future of the bonus system in the civil service. At one stage in the negotiations the authorities desired to convey to the staff side of the National Council certain important alternative proposals dealing with the subject under discussion, and for this purpose

the permanent secretary of the Treasury thought it necessary to invite representatives of various sections of civil service opinion to an informal discussion.

WHILE informal discussions may serve a useful purpose, it is worth while asking why no representative was included of the professional and scientific interests in the civil service, of which the Institution is the accredited spokesman, although among those invited was the representative of at least one smaller body representative of non-technical interests. Official representations from the Institution were put aside on the ground that the conversations were 'informal', although the attempt was afterwards made to treat as negotiators the four individuals selected. We could have perhaps understood, even if we had deplored, this failure to acknowledge the existence of the specialist interest in the civil service, were it not for the fact that the Institution's position has already been recognised by its special direct representation on the National Council to which we have referred. It is a curious revelation of official psychology that it should be thought unnecessary to consult with this distinctive and, we claim, this essential element in the modern civil service, upon a major issue affecting specialists in common with other types of civil servants.

Taxes on Books in Australia

MR. LYONS' Government in Australia, "having given very earnest consideration to requests that the taxation burden on educational literature should be lightened", has, we learn from an announcement in the Melbourne *Argus* of June 3, granted certain exemptions which, though satisfactory so far as they go, are very meagre concessions compared with the case against a tax on books of any kind. Primage duty at port of entry will no longer be charged on books and periodicals imported by or for the State public libraries, the National Library at Canberra, and the libraries of the several universities. Hymn books, prayer books, and literature published by or issued under the authority of the League of Nations will also be admitted free; and so will historical records in print, picture, or manuscript imported by or for libraries. Unfortunately, the sales tax still remains.

Alleged Psychic Phenomena

IN a long letter to NATURE, Mr. Harry Price, the honorary director of the National Laboratory of Psychical Research, has commented upon the review of Dr. Osty's book, "Les Pouvoirs inconnus de l'esprit sur la matière", published in these columns on June 25. He states that both Mr. Malcolm and Mr. Lambert changed their views regarding the alleged psychic phenomena produced by Mr. Rudi Schneider, although Mr. Lambert, according to the letter quoted by Mr. Price, merely says that, in his opinion, there was no possibility of the *medium* having produced the phenomena fraudulently. It is clear that these later opinions were not based on personal observation but from reading the record of others. Again, Mr. Price dismisses, without apparently realising its relevance, the incident of the match-box, suggesting, as it does, the invasion of the séance room from without, suspected for so long by competent observers. Moreover, in upholding the genuineness of Mr. Schneider's phenomena, Mr. Price declares that the opinions quoted in the review were from persons who had *a priori* convictions that the mediumship was a fraud—a statement in support of which he offers no evidence and which is almost certainly contrary to fact.

Physics and Psychics

IN conclusion, Mr. Price emphasises his own views on the independent examination of mediums by remarking that it has been his practice to introduce them to men of science of repute in order to encourage independent investigation; and in this he claims some considerable success. It must be remarked, however, that the invitations issued by the late Dr. von Schrenck-Notzing, the late Dr. G. Geley, and by Mr. Price were not for the purpose of granting any true scientific inquiry. The persons invited were merely privileged spectators of phenomena produced under conditions over which they had little control and in circumstances where accuracy of observation was almost impossible. Mr. Price claims that the phenomena described by Dr. Osty have been duplicated by him with similar results, and that when Mr. Schneider is in London in September of this year he will be pleased to invite assistance from physicists. What is wanted, however, is not the mere presence of experts at the experiments of others in an atmosphere which, rightly or wrongly, cannot fail to arouse suspicion. It is an arrangement whereby the alleged influence at a distance, which, it is claimed, can be measured and detected by purely physical means, is so measured and examined by independent observers in their own laboratories, with their own apparatus, and under those conditions most favourable to accurate scrutiny.

Early Man in America

IT is a not infrequent occurrence in America for discoveries to be announced which, it is said, afford indubitable evidence of the existence of man on that continent in very early times. Usually this evidence takes the form of one or more stone implements associated with the bones of extinct mammals, such as an elephant, in deposits held to be Pleistocene and in conditions which are claimed to justify the conclusion that the implements and fossils are contemporary. Usually it appears on further investigation that it is either impossible to verify the exact position, relative or absolute, of the finds, or an application of the strict canon of evidence reveals some flaw which vitiates the conclusion. American palæontologists and archæologists, however, continue to examine with patient determination every claim that is reported, and at the same time to examine diligently areas in which the deposits are such as might well afford the evidence which is sought. One such area is the State of Nebraska, which, in view of its geographical relation to the glacial area of the ice age, is regarded by

American geologists as of great promise in this respect. Three discoveries have been reported in this State recently, according to Science Service of Washington, D.C. In two instances, students of the University of Nebraska have discovered flint implements in association with the bones of fossil bison under some sixteen feet of loess which, it is claimed, is earlier than the last glaciation. These two discoveries lie about sixty miles apart. The third discovery was near the town of Angus, where, it is claimed, a flint implement was found under the scapula of a mammoth. The sites have been visited by Dr. W. D. Strong, of the Bureau of American Ethnology, who regards the discoveries with very considerable reserve.

Antiquities from the Ancient East

ON July 11 two exhibitions of antiquities found in the course of excavations during the past season were opened in London, at University College, Gower Street, and at the British Museum. At University College, Sir Flinders Petrie has on exhibition the finds of the expedition of the British School of Archæology in Egypt at Tell el-Ajjul, the ancient Gaza. The antiquities from the Hyksos levels will give an added attraction to the exhibition in the estimation of the general public; but the real interest of the collection as a whole lies rather in its extent and completeness in range over Palestinian cultures from the copper age to the time of the eighteenth dynasty and later. A quantity of pottery from the Ægæan and Mycenæan civilisations, from Egypt, Cyprus, and elsewhere, indicates the importance of the site as an early meeting point of international lines of communication. Particularly to be noted among the exhibits are fine daggers of the copper age, alabaster vases of the eighteenth dynasty, and glass of the same period. Two finds to which attention has been directed in preliminary reports on the season's work—the group of battered vessels and gold and silver, associated with burnt bones, which seem to be of the nature of a comminatory offering, and the gold ornament of torc form for which Irish affinities have been suggested—will certainly attract notice. The exhibition will remain open for four weeks.

AT the British Museum the collection of antiquities yielded by the past season's excavations at Ur will remain on exhibition for a period of three months. The character of the work, although it was essential and might have proved of the greatest value scientifically, was not such as would be likely to afford spectacular results for exhibition purposes comparable with those of recent years. There is, however, a number of gold frontlets and beads and a striking terra-cotta figure of a god with a mitre of bull's horns in the best tradition of Ur. There are also a limestone statuette of the goddess Pa-Sag and a copper statuette of the same deity, the latter discovered in the pedestal of a limestone figure. These belong to the third dynasty. A steatite bowl of the same period shows the figures of five oxen as decoration. One of the most interesting items in the collection is the steatite stamp seal assigned to Mohenjo-daro as its place of origin, on which are engraved an Indian buffalo and an inscription in the script of the Indus valley. Mention must also be made of the collection of types of beads from about 4000 B.C. down to the Persian era of the fourth century B.C., and the collection of seal-impressions from various sources which, it is inferred, were once the property of a jewel collector at Ur.

The Freshwater Biological Association

THE annual general meeting of the Freshwater Biological Association of the British Empire was held on June 29, and Mr. Reginald Beddington was elected president. The Report for the year shows that the Association, which was established as the outcome of a discussion at the meeting of the British Association at Glasgow in 1928, has made considerable progress during the past year. Support has been received from the Development Commissioners, scientific societies, waterworks associations, fishery boards and angling associations, and many private individuals. The interests of anglers are very closely concerned with research into the conditions existing in fresh waters, but not as much help as was expected has been received from those directly interested in angling. In September the Association opened a laboratory on the shore of Lake Windermere, certain rooms in Wray Castle, a property owned by the National Trust, having been equipped for this purpose. There are two naturalists employed in research at the laboratory, and there is accommodation for visiting research workers. A number of workers from Great Britain and from abroad have already occupied tables in the laboratory. There is a launch for work on the lake, and this launch is fully equipped for hydro-biological research. In extending its programme of research the Council of the Association has felt the difficulty of a lack of funds. A special appeal is made to all who are interested in fresh waters to support the Association. The address of the honorary secretary is Mr. J. T. Saunders, Christ's College, Cambridge.

Photographic Copying by Contact

IN the early days of photography, the late Mr. J. H. Player invented a method of making full-sized copies of black and white print, drawings, etc., without the use of a camera or lens. The process, known as 'playertype', is easily worked and may sometimes be used with advantage. The drawing to be copied is taken to the dark room. A sheet of ordinary bromide paper, or a photographic plate, is placed with its sensitive surface in close contact with the drawing. The paper is then exposed for a short time to the light from any convenient ordinary source of white light of low power. The light passes through the paper and its sensitive coating, illuminating the drawing beneath. Less light is reflected back from the black lines of the drawing than from the white ground. Thus the total illumination of the sensitive coating opposite the black lines is less than that opposite the white ground. On developing the sensitive material a somewhat foggy negative is obtained. This negative can be used for

printing any number of photographic copies in the usual way. Recently this process has been revived by Messrs. Luminophor, Ltd., 27 Queen Victoria Street, London, E.C.4, who supply phosphorescent screens to replace the ordinary light source of the original 'playertype'. One of the screens must first be excited by exposure to daylight or to magnesium light. It is then placed upon the bromide paper and drawing and allowed to remain for some minutes. Subsequent operations are similar to those already described for 'playertype'. However, while these phosphorescent screens are sometimes convenient, they are costly and really quite unnecessary.

Beit Memorial Fellowships for Medical Research

The following elections have been made by the Trustees of the Beit Memorial Fellowships for Medical Research, the subject and place of research being indicated after the name:—*Senior Fellowship in Tropical Medicine* (£1000 a year, for one further year): Dr. E. Hindle, spirochætosis, with special reference to the causation of yellow fever. *Fourth Year Fellowships* (value £500 a year): Dr. C. L. Cope, excretion by the mammalian kidney of the glomerular dyestuffs and of the inert sugars believed to be excreted only by the glomeruli (Radcliffe Infirmary and Department of Biochemistry, Oxford); Margaret Honora Roscoe, to continue work on the vitamin B complex (Lister Institute of Preventive Medicine, London); Mr. K. A. C. Elliott, to complete work on peroxidases, and then to study tissue respiration from the point of view of carbon dioxide evolution (Sir William Dunn Institute of Biochemistry, Cambridge). *Junior Fellowships* (£400 a year): Dr. H. P. Himsworth, activation of insulin by a possible kinase and effect of diets of varying composition on diabetic patients (University College Hospital Medical School, London); Mr. N. R. Lawrie, biochemical investigation of the nutritional requirements of Protozoa and the study of patients with abnormal metabolism of sulphur-containing compounds (Sir William Dunn Institute of Biochemistry, Cambridge, and Addenbrooke's Hospital, Cambridge); Dr. D. H. Williams, carbohydrate metabolism, particularly the storage of liver glycogen in experimental animals (Department of Physiology, University College, London); Mr. D. W. W. Henderson, antibacterial mechanisms in prophylaxis and therapy of tetanus; cultivation of the viruses of louping ill and fowlpox (Lister Institute of Preventive Medicine, London); Dr. R. G. R. West, neurological mechanism of tetany and the pharmacology of curare (Physiological Department, St. Bartholomew's Hospital Medical School); Dr. R. Gaddie, intermediate carbohydrate metabolism of isolated frog's heart; mode of action of insulin in the animal body (Departments of Medical Chemistry and Materia Medica, University of Edinburgh); Mr. F. G. Young, storage of carbohydrate by the liver in experimental animals (Departments of Physiology at University College, London, and at the University of Aberdeen); Dr. J. M. Robson, hormonic factors responsible for the maintenance of pregnancy and onset of parturition (Institute of Animal Genetics, Edinburgh).

Beit Fellowships for Scientific Research

BEIT Fellowships for Scientific Research of the annual value of £240 and tenable at the Imperial College of Science, South Kensington, have been awarded to Mr. R. M. Shackleton (University of Liverpool and Imperial College), for research on the geology of the area about Moel Hebog; Mr. E. G. Jones (University College, Nottingham, and the Einstein Institute, Astrophysics Observatory, Potsdam), for research on hyperfine structure of spectral lines; Mr. R. L. Rosenberg (Universities of Cape Town and Berlin), for theoretical investigations in topics connected with quantum mechanics; Dr. O. B. Westcott (University College, Exeter), for research on the electro-deposition of tin with the view of establishing the precise conditions under which crystalline deposits may be obtained and avoiding the unsatisfactory spongy deposits which result from present processes. In addition, the fellowships awarded a year ago to Mr. W. H. Wheeler, for research in chemical technology, and Mr. J. I. Armstrong, for plant physiology research, have been extended for a second year.

Cancer Research

THE ninth annual report of the British Empire Cancer Campaign, presented at the annual meeting on July 11, illustrates the diversity of ways in which the cancer problem is being approached—observational, experimental, and clinical. The best discovery announced is the identification by the Cancer Hospital Research Institute of a pure chemical substance—1 : 2 : 5 : 6 - dibenzanthracene — which causes epithelial and connective tissue tumours in the great majority of treated animals. Some progress has also been made in perfecting an antiserum which will cure mouse tumours, but it remains questionable whether there is much prospect of applying the method successfully to human cases. The account of cancer as a gene mutation lacks something in historical perspective: it does no more than translate Boveri's hypothesis into modern terminology.

Wool Production in the Empire

THE Wool Industries Research Association and the Empire Marketing Board are to be congratulated on their joint effort to make a survey of the conditions of wool production throughout the British Empire, particularly from the point of view of assessing the factors, economic and biological, which play a part in controlling production in different areas. The report, the result of a three years' survey by J. E. Nichols, has just appeared under the title "A Study of Empire Wool Production" (Wool Industries Research Association, Leeds; 5s. net). In 148 pages it would be impossible to follow all the vagaries of wool production, but Mr. Nichols has made the most of his space by discussing three main aspects: the conditions under which wool production occurs, and this includes geographical conditions as well as the conditions of the fleece itself; the phases of wool production in the Empire, which means that the breeds of sheep, the qualities of the wools, the factors affecting the industry, are discussed for each country

in turn; and finally, Part 3 "constitutes an attempt to analyse the concept of wool improvement and an examination of methods of development of its production".

Academy of Natural Sciences of Philadelphia

IN an attractive *Year Book* for 1931, it is recorded that the 120th year of the Academy's existence was signalised by notable activities in many directions. In each of the three major fields—laboratory studies, expeditions, and museum exhibits—the year set new records for this oldest institution of its kind in America. During the year, twenty-two expeditions for organised collecting, sponsored wholly or in part by the Academy, obtained material for study or exhibits from North, South, and Central America, as well as from Asia and Africa, and covered more than 175,000 miles during their quests. One result is seen in the addition of more than 8700 new specimens of vertebrates alone to the study collections. That the museum side of the Academy's activities arouses growing interest is indicated by the increased number of visitors, which for the first time exceeded 100,000; but the photographs of the cases of small mammals in the North American hall give an impression of the grouping of incongruous species, which suggests that here there is still room for the development of artistic natural groups. It is announced in *Science* that the following have recently been elected correspondents of the Academy: Prof. L. H. Bailey, Dr. H. B. Bigelow, Prof. R. A. Daly, Dr. Ludwig Diels, Prof. J. Stanley Gardiner, Prof. Hugo Glück, Prof. W. D. Gregory, Prof. A. S. Hitchcock, A. Lutz, Prof. E. de Margerie, Prof. E. D. Merrill, E. W. Nelson, Prof. A. C. Seward, Dr. E. O. Ulrich, and Mr. B. P. Uvarov.

Eradication of Slugs and Snails

SLUGS and snails are some of the most widespread pests on farms and in gardens, but owing to their nocturnal habits and their capacity for excreting slime which enables them to get rid of irritating substances, they are very difficult to control. Their natural enemies, for example, various birds, toads, moles, and predaceous ground beetles, are insufficient to keep their numbers in check, and special means of control are often necessary. Though no means of absolute eradication of these pests is as yet known, the Ministry of Agriculture has published an *Advisory Leaflet* (No. 115), in which various check measures are described. In gardens, large numbers of slugs may be caught by means of traps consisting of cut potatoes, orange skins, cabbage leaves, tiles, boards, or sacking placed on the soil, for the animals will collect under them for shelter during the day. Hand collecting at dusk is also recommended. For larger areas, the use of certain chemicals with a corrosive or toxic action is advised. Quicklime or salt are destructive if they come in contact with the upper part of the slugs' bodies, and applications made at night (or two or three times during the same night, if possible) should prove useful. Barriers of repellent material such as soot, washing soda, 'dry Bordeaux', etc., are often successful, and recent trials have shown that 1 part creosote mixed with 100 parts of precipitated chalk placed around each plant at the rate of ½ oz. per plant is worth further trial.

Forest Fires

LEAFLET No. 9 issued by the Forestry Commission (H.M.S.O., 1931) deals with this subject, which is of growing importance in Great Britain. The type of forests most subject is the coniferous; outside tropical regions, fires in forests of broad-leaved trees are less dangerous. Woodland fires are not new in Great Britain, and in dry seasons they have been only too prevalent on commons. The Forestry Commission attributes twenty-five per cent of the fires occurring nowadays in its new forests to carelessness on the part of picnickers and wayfarers. Since the advent of the Forestry Commission and the large coniferous planting campaign which has been inaugurated under its auspices during the past twelve years, the forest fire problem has entered upon a new phase. The most common form of danger is the surface or ground fire, burning dead leaves, etc., on the forest floor. The stem and crown fire is rarer in Great Britain. Newly planted areas are in greatest danger during March and April, although a dry February produces the same conditions. During a summer drought the danger reappears. The grass, under the influence of dry east winds or a summer drought, becomes as dry as tinder, and a cast-away lighted match or burning cigarette-end will start a fire which will quickly get out of control of the perpetrator of the act. After pointing out the various dangers to plantations situated under differing conditions, the leaflet deals with various methods of control, such as lay-out of plantations, order of felling, removal of debris, patrolling, equipment of tool depots, clearance of growth outside plantations, importance of immediate action, counter-firing, and the measures to be taken after the outbreak.

The Making of Factories

IN *Helios* for March 20, the export journal of the *Zeitschrift für die Elektrotechnik*, there is an interesting account of the Gladitz Company of Berlin, the main business of which is to instal and equip completely in every detail lamp-making factories. Any one willing to start a factory for electric lamps need have no technical knowledge of the subject. For example, a capitalist in Mexico City recently ordered a modern lamp-making factory. The plans for the building were prepared by the company and it was erected under the supervision of a local architect. During this time the necessary equipment, down to the smallest detail, was made in Germany. German engineers then went to Mexico and installed the machinery. They took with them a staff of male and female workers. The Mexican labourers, both men and women, were instructed by this staff. In a year's time the instructors had all left, the only German remaining being the technical manager. Three months after the building was erected, lamps began to be manufactured, and the production is now 16,000 per day. The contract comprises the supply of all machines and accessories, the factory organisa-

tion, the instruction of local labour, continuous control, and consultation. The Gladitz Company has already installed complete factories in many countries of the world, with departments for wire treating, glass treating, exhausting, and finishing the lamps. It is interesting to notice that several of these factories are now being controlled by the large lamp companies. The company considers that this is a compliment to the work turned out by the factories it has started. It is busy at present in developing practical manufacturing methods of making neon signs for manufacturing purposes.

Precautions in Use of Electro-Medical Apparatus

SERIOUS accidents from the use of electro-medical apparatus have so far been few in number, but the risk is likely to increase in the future, owing to more extended use of such appliances and also to the tendency to make use of the standard alternating current of 230 volts. Industrial experience shows that serious shock is more likely to result from alternating than from direct currents of the same voltage. The Ministry of Health has therefore issued a Memorandum (Mem. 161 Med.) with covering Circular (No. 1267) directing attention to precautions that ought to be taken in the use of electro-medical appliances, adoption of which should go far to minimise the risks involved.

Researches from the University of Sydney

The published work of members of the University of Sydney is made more generally available by the issue of collected reprints, which are now classified in twelve series, according to the nature of the research. We have recently received vol. 1, Reprints Nos. 18-24, in Series I. (Agricultural and Veterinary Science), vol. 1, Reprints Nos. 22-32, in Series VIII. (Medical Sciences—Clinical), and vol. 3, Reprints Nos. 1-19, in Series IX. (Medical Sciences—Non-Clinical). Most of the papers have been published within the last two years; a few are of less recent date. Most, but not all, were originally published in Australian journals. The range of subjects dealt with in each volume is wide, and indicates that an active spirit of research animates Australian scientific workers.

Hawaiian Volcano Observatory

WE regret to learn that, from July 1, the annual fund allotted to volcanology through the U.S. Geological Survey has been reduced from 35,000 to 15,000 dollars. Most of this sum is required for the work of the Hawaiian Volcano Observatory, and one of the first results of the reduction is that the weekly *Volcano Letter*, first issued in 1925, is to be replaced by a monthly leaflet. There will be no suspension of the research work, though the staffs at all the stations, in Hawaii, California, and Alaska, will be reduced.

Announcements

THE fifteenth Faraday Lecture of the Chemical Society will be delivered by Prof. P. Debye, of Leipzig, on March 29, 1933.

DR. H. R. MILL, who during his long association with the Royal Geographical Society has been actively engaged in the promotion and preparation of the polar expeditions of the past forty years or so, has been appointed by the King of Norway a Commander (2nd Class) of the Order of St. Olav, for his services to Norwegian arctic explorers. This order has previously been conferred upon Sir Clements Markham, Sir Ernest Shackleton, and Sir John Scott Keltie.

MRS. BOWEN, Titcomb Manor, Kintbury, Berks, informs us that she has fifteen bound volumes of NATURE, namely, vol. 45 to vol. 60, extending from Nov. 1891 to Oct. 1899, with the exception of vol. 54, which she generously offers to present to a suitable college, institute, or scientific worker, in need of them, upon payment of carriage. Communications should be sent direct to Mrs. Bowen at the above address.

A SPECIAL volume (vol. 9) of the *Australian Journal of Experimental Biology and Medical Science* has been issued as a memento of the late Prof. Brailsford Robertson, who founded the *Journal* and, until his death in January 1930, was its chief editor. The volume contains a biographical account of his scientific work, a bibliography of his writings, and nineteen papers specially contributed by his former colleagues and pupils, who are all acknowledged authorities on the subjects on which they write. The volume forms a unique and interesting collection of papers on those biochemical aspects of biological science to which the late Prof. Robertson during his lifetime made such notable contributions, both directly by his own individual work and indirectly by his inspiring influence on a wide circle of colleagues and pupils.

THE annual Report of the Governing Body of the Lister Institute of Preventive Medicine, recently issued, announces that Prof. William Bulloch has been elected chairman of the governing body, in succession to the late Sir David Bruce. An excellent survey of the numerous researches carried out by workers at the Institute is presented. The National Collection of Type Cultures, housed at the Institute, has had two hundred cultures added, and has distributed more than five thousand cultures, during the year.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in zoology at the University of Birmingham—The Secretary (July 17). A lecturer in electrical engineering and physics at the Borough Polytechnic, Borough Road, London, S.E.1—The Principal (July 18). A principal of the College, and a headmaster of the College Secondary School, Swindon—The Director of Education, Education Office, Clarence Street, Swindon (July 21). A principal of the new Technical School, Hong-Kong—The Secretary (SIR/CA), Board of Education, Whitehall, London, S.W.1, or, for Scottish applicants, The Secretary, Scottish Education Department, Whitehall, London, S.W.1 (July 23). A lecturer in zoology at University College, Nottingham—The Registrar (July 30). A demonstrator in biology at Guy's Hospital Medical School, London Bridge, S.E.1—The Dean (Aug. 5).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Oxygen Affinity of Chlorocruorin

CHLOROCRUORIN is the respiratory pigment in the blood of certain polychæte worms. Working in the laboratory of Dr. R. Wurmser in Paris, I have investigated the oxygen affinity of the specific chlorocruorin of *Spirographis spallanzanii*. The blood was diluted to approximately 6 parts in 1000 parts of 0·6 *M* phosphate buffers. In each experiment, 3 c.c. of the diluted blood was placed in a 300 c.c. glass saturator, to one end of which a small trough with parallel glass faces 2 cm. apart was attached. The oxygen pressure in the saturator was varied by measured amounts, and the solution equilibrated at

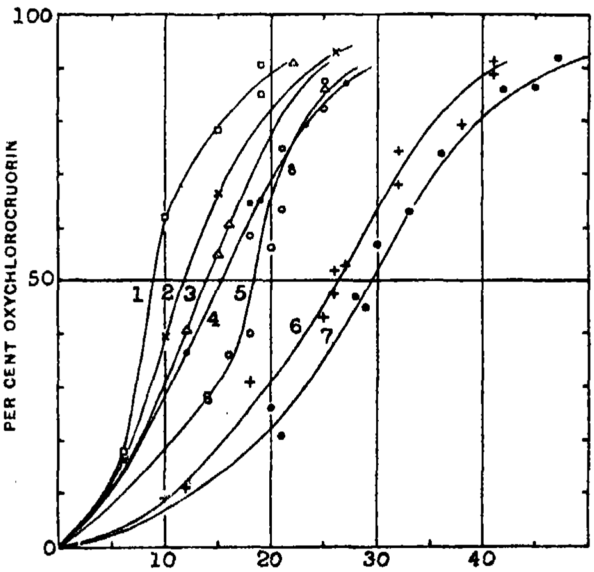

FIG. 1.—Oxidation dissociation curves of chlorocruorin. 1, *p*H 8·0, 10°; 2, *p*H 8·2, 20°; 3, *p*H 8·0, 20°; 4, *p*H 8·0, 26°; 5, *p*H 7·7, 10°; 6, *p*H 7·7, 20°; 7, *p*H 7·35, 26°.

each oxygen pressure by rotating the saturator horizontally in a thermostat. The saturator was then placed vertically with its trough in the course of the light beam of a spectrophotometer. The relative concentrations of oxy- and reduced chlorocruorin were obtained by measuring the light absorption at the wave-lengths in the visible region of the spectrum (604·5 and 580·5 mμ) where there is the greatest difference between the oxidised and reduced pigment.[1]

The results obtained are shown in Fig. 1. The *p*H limits are dictated by the fact that chlorocruorin is unstable above *p*H 8·5 and below *p*H 7·0. Both hydrogen ion concentration and temperature affect the oxygen affinity of chlorocruorin in a similar manner to mammalian hæmoglobin. The temperature coefficients (Q_{10}) of the reaction between chlorocruorin and oxygen (in the buffer solutions used), calculated from the oxygen pressures corresponding to 50 per cent saturation, are 1·6 at *p*H 8·0 and 1·5 at *p*H 7·7. Human whole blood at 38° is 50 per cent saturated with oxygen at an oxygen pressure of 29 mm. Hg, in presence of 40 mm. CO_2.[2] The same is seen to be true for diluted *Spirographis* blood at 26° and *p*H 7·35. The oxygen affinity of chlorocruorin at the temperatures at which the animal lives is, therefore, of the same order of magnitude as that of hæmoglobin in the human body.

The limiting temperatures studied, 10° and 26°, were chosen because the former is that of the winter sea in Brittany, the latter that of the summer sea at Algiers. These are extremes in the habitat of *S. spallanzanii*. It seems probable that the temperature effect on the oxygen dissociation curve is one of the limiting factors in the geographical distribution of poikilothermal animals having respiratory pigments. At too high a temperature the oxygen affinity of the chlorocruorin of *S. spallanzanii* would be so much diminished that there would be an insufficient difference in oxygen pressure between blood and tissues for the latter to receive oxygen at a rate necessary to maintain life.

H. MUNRO FOX.

Zoological Department,
University of Birmingham,
June 3.

[1] Fox, *Proc. Roy. Soc.*, B, **99**, 199; 1926.
[2] Brown and Hill, *Proc. Roy. Soc.*, B, **94**, 297; 1923.

Raman Spectrum of Nitrous Oxide

WE have photographed the Raman spectrum of nitrous oxide with a four-prism glass spectrograph having a camera lens of diameter 5 cm. and focal length 70 cm. The gas was at a pressure of 30 atmospheres and was illuminated with four 32 cm. long mercury lamps, container and lamps being surrounded by a reflector of suitable shape. The exposure time was 14 days, the spectrograph being, of course, enclosed in a thermostat. Average values of the frequency shifts obtained are listed in the first column of the accompanying table. In the third column are stated the transitions to which the Raman lines are ascribed, the quantum numbers V_1, V_2, V_3, and *l*, introduced by Dennison,[1] being used to designate the vibrational states of the molecule. The fourth column, finally, gives the values of the frequency shifts as computed from the recent infra-red absorption measurements of Plyler and Barker.[2]

Frequency (observed), cm.⁻¹.	Intensity.	Transition.	Frequency (computed), cm.⁻¹.
1170	weak	0000 ⟶ 0200	1167·3
1185	weak	0000 ⟶ 020 ± 2	1179
1260	weak, broad	Max. *PP*-branch	1256
1282	weak	010 ± 1 ⟶ 110 ± 1	1279
1286·5	very strong	0000 ⟶ 1000	1285·4
1315	weak, broad	Max. *RR*-branch	1314
2210	weak	010 ± 1 ⟶ 011 ± 1	2210·1
2223·2	strong	0000 ⟶ 0010	2224·1

The frequency shift of 1286·5 cm.$^{-1}$ was measured three times, being excited by the mercury lines 4047 A., 4078 A., and 4358 A. All the other frequency shifts were measured twice, being excited by 4047 A. and 4358 A. The values obtained for the two strong Raman shifts are probably correct to less than 1 cm.$^{-1}$. They are in fair agreement with the value 1282 cm^{-1}. found by Dickinson, Dillon, and Rasetti,[3] and the values 1283 cm.$^{-1}$ and 2226 cm.$^{-1}$ obtained by Bhagavantam.[4] The ratio between the intensities of the two strong lines may well be 10 to 1, as stated by Bhagavantam. However, with lines so far apart, it is impossible to make a really quantitative estimate of the intensities by mere visual inspection of the plate.

So far as we are aware, none of the weak lines has been observed before. The only lines about the reality of which there may be some doubt are the two

lines corresponding to the frequency shift 1282 cm.$^{-1}$. The difficulty of settling the reality of these lines exists because they lie close to the very strong lines corresponding to the shift 1286·5 cm.$^{-1}$, which lines appear to have an unsymmetrical intensity distribution, with the greatest broadening towards long wave-lengths.

The agreement between the frequency shifts observed in the Raman spectrum and those computed from Plyler and Barker's infra-red measurements is very good, and hence the interpretation given in the third column of the table seems scarcely open to doubt. While all the other Raman frequencies are interpreted as Q-branches, the broad lines having shifts of 1260 cm.$^{-1}$ and 1315 cm.$^{-1}$ undoubtedly represent the maxima of PP- and RR-branches. From their separation from the Q-branch at 1286·5 cm.$^{-1}$, we obtain the value of 61×10^{-40} gm. cm.^{2} for the moment of inertia of the molecule, in good agreement with Plyler and Barker's value $59{\cdot}4 \times 10^{-40}$. It is an interesting fact, also found with liquid carbon disulphide [5] and in perfect accord with the selection rules of Placzek,[6] that the transitions $0000 \rightarrow 010 \pm 1$ do not occur in the Raman spectrum, while the 'overtones' $0000 \rightarrow 0200$ and $0000 \rightarrow 020 \pm 2$ occur, although with low intensity. Our results strongly support the conclusion that the nuclei in the nitrous oxide molecule are linearly and unsymmetrically arranged.

One of us (J. R. N.) is indebted to the John Simon Guggenheim Memorial Foundation for the grant of a fellowship.

A. LANGSETH.
J. RUD NIELSEN.
University Chemical Laboratory and
Institute for Theoretical Physics,
Copenhagen, June 8.

[1] D. M. Dennison, *Rev. Mod. Phys.*, **3**, 280; 1931.
[2] E. K. Plyler and E. F. Barker, *Phys. Rev.*, **38**, 1827; 1931.
[3] R. G. Dickinson, R. T. Dillon, and F. Rasetti, *Phys. Rev.*, **34**, 582; 1929.
[4] S. Bhagavantam, NATURE, **127**, 817; 1931. *Indian J. Phys.*, **6**, 319; 1931.
[5] Cf. D. M. Dennison and N. Wright, *Phys. Rev.*, **38**, 2077; 1931.
[6] G. Placzek, *Leipziger Vorträge*, 1931, p. 71.

Dielectric Constant of Liquid and Solid Nitrobenzene

THE change of the dielectric constant of nitrobenzene with temperature was examined by J. Mazur,[1] who discovered that the value of the dielectric constant in the liquid phase drops abruptly from 38·15 at 9·6° to 11·82 at 7·7°. M. Wolfke and J. Mazur [2] try to explain this behaviour by the change of the structure of the molecule at the temperature of 9·6°, which temperature is said to separate from each other two modifications of nitrobenzene. In order to verify this, I have carried out at different temperatures measurements of the electric polarisation of diluted solutions of nitrobenzene in hexane. The results of these investigations, which will be dealt with in a special publication, show *inter alia* that the nitrobenzene molecule when passing the point 9·6° does not suffer a change of either electric moment or polarising power; [3] moreover, no such change occurs at any temperature between − 4° and + 30°.

I therefore determined to repeat the measurements of J. Mazur. I have investigated the dielectric constant of nitrobenzene in the temperature interval − 3·70 and + 50°. The nitrobenzene was specially

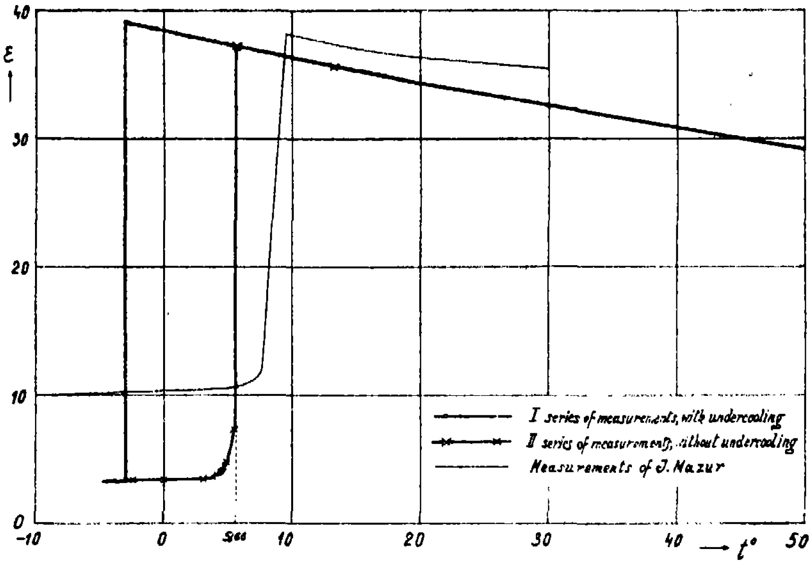

FIG. 1.

purified, for example, by repeated distillation and crystallisation, and dried by bubbling through it for several hours dried and carbon dioxide free air. The condenser was made of thermometric glass and platinum. The temperature was measured outside the condenser (in the oil bath) as well as inside. The results are shown in Fig. 1, and are quite inconsistent with those obtained by J. Mazur. The curve showing the change of dielectric constant with temperature does not show any peculiar point at the temperature of 9·6°. On the other hand, a quite abrupt decrease of the dielectric constant takes place at the freezing of nitrobenzene. This can occur at any temperature below the freezing point (+ 5·66°) provided the nitrobenzene is undercooled (first series of measurements), or at 5·66° without undercooling (second series of measurements). In the latter case, the dielectric constant drops abruptly from 37·25 to 7·36, after which it rapidly decreases to 3·44 at 0°.

Similarly, the density-temperature curve of nitrobenzene shows no inflexion at 9·6°, as found by Mazur,[4] and, therefore, the electric polarisation of liquid nitrobenzene shows no abnormalities down to the freezing point.*

The discrepancy between Dr. Mazur's results and mine are, I think, due, as Prof. Wolfke has suggested to me, first to the method of purifying and the degree of purity of this unusually capricious substance, and, secondly, it may be caused by some hitherto and as yet unknown conditions of obtaining nitrobenzene II, which conditions have been observed by some investigators [5] but not by others.

A. PIEKARA.
Physical Laboratory, Sulkowski Gymnasium,
Rydzyna, Poland,
May 25.

* The same refers to the molecular refraction.

[1] NATURE, **126**, 993; 1930.
[2] NATURE, **128**, 584; 1931.
[3] In agreement with the recent results of M. Wolfke and S. Ziemecki (*Acta Physica Polonica*, 1, 271; 1932), who found no abnormalities in the refractive index or in the Raman spectrum of nitrobenzene.
[4] NATURE, **127**, 893; 1931.
[5] Cf. the paper of G. W. Stewart (*Phys. Rev.*, **39**, 176; 1932), who obtained positive results when investigating the point of transformation of ethyl ether and nitrobenzene by means of X-rays.

The Connexion between the Eötvös Magnitudes

IN the problem of locating subterranean anomalies of density, the Eötvös balance measures two quantities, the horizontal gravity gradient and the difference between the principal curvatures of the level surface at the point of observation. In the two-dimensional case these reduce to U_{xz} and $-U_{xx}$, denoted by $G(x)$ and $K(x)$ respectively. In all treatments of the subject which I have seen $G(x)$ and $K(x)$ appear to be considered independent of one another. It can be shown, however, that there is a one-to-one relation between the two functions, namely, that they are conjugate trigonometrical integrals of one another;[1] in fact:

$$G(x) = \frac{1}{\pi}\int_0^{\infty} d\alpha \int_{-\infty}^{+\infty} K(t) \sin \alpha(t-x)dt$$

and $$K(x) = -\frac{1}{\pi}\int_0^{\infty} d\alpha \int_{-\infty}^{+\infty} G(t) \sin \alpha(t-x)dt,$$

or,

$$G(x) = \frac{1}{\pi}\int_0^{\infty}\frac{K(x+t)-K(x-t)}{t}dt = \frac{1}{\pi}P\int_{-\infty}^{+\infty}\frac{K(t)}{t-x}dt$$

and

$$K(x) = -\frac{1}{\pi}\int_0^{\infty}\frac{G(x+t)-G(x-t)}{t}dt = -\frac{1}{\pi}P\int_{-\infty}^{+\infty}\frac{G(t)}{t-x}dt$$

where P denotes the principal part of the subsequent integral.

The second of these pairs of formulæ in particular enables one of the quantities to be obtained from the other, whether given in functional form or as a series of observations.

These results depend solely on the density anomalies lying all on the same side of Ox; which is, of course, the usual thing, the observations being made along the surface of the ground. They do not depend on the density changes being either continuous or discontinuous.

In the recent experimental survey in Australia[2] it is stated that the gradiometer, which only measures $G(x)$, is more satisfactory from a practical point of view than the torsion balance; it appears now that the latter instrument provides no further information than the former, so far as two-dimensional structures are concerned, since the measurement of $K(x)$ as well as $G(x)$ is redundant, or is only a check.

O. F. T. ROBERTS.

University of Aberdeen,
June 4.

[1] E. C. Titchmarsh, *Proc. L.M. Soc.*, II., **24**, p. 109.
[2] "Geophysical Prospecting", Imperial Geophysical Experimental Survey, p. 173.

Swarming of Collembola in England

A RECENT letter in NATURE[1] directed attention to instances of swarming of certain species of Collembola. It was stated that "In most . . . cases . . . (if not all) the factor producing this phenomenon would seem to be the relative abundance of the food supply". In another instance it was suggested that "migration *may* account for swarming".

While in agreement with the first suggestion as a possible explanation of this swarming habit, certain observations made from time to time during studies on this order of insects might assist in carrying the subject a stage further. In September 1928 I examined, by means of a binocular microscope, the habits of individuals in a swarm of *Podura aquatica*, L. I was at first surprised at the number of head-capsules of adults which could be seen in the colonies; each head-capsule was completely devoid of all save the merest traces of the body. Observations revealed the fact that under these conditions the Collembola were carnivorous, and even cannibalistic, in habit. Individuals could be seen vigorously attacking other members of the swarm; the point of attack was evident, in some cases, by a drop of body fluid which exuded. During an attack the victim struggled and fought with mouth-parts and tarsal claws, but was gradually overpowered. When it succumbed, several other members of the swarm quickly collected around its mutilated body and devoured it, until the head-capsule alone remained. This habit appeared not only to provide food for the support and development of the colonies but also was a factor in keeping the small groups of the Collembola together while they fed, collectively, on the scattered dead bodies. Individuals about to moult proved ready prey for the more active members of the swarm.

A similar observation was recorded to a lesser extent among *Hypogastrura* spp. The swarming of *Sminthurus viridis*, Lubb.—a species which is mainly phytophagous in habit—has not been observed, but it has been a common experience, in heavily infested fields, to find that this species will readily congregate and devour specimens that had recently died.

I am not aware of any reference to this interesting habit among Collembola, and this no doubt explains why the observed species can remain congregated in swarms for long periods in such barren sites as surface water in cart ruts, bare stones, and even on tap water in glass dishes.

A factor which undoubtedly affects this swarming habit is humidity. It has been shown[2] that species of Collembola, particularly atracheate forms, require a saturated atmosphere to survive any length of time. Individuals, therefore, tend to congregate in local environments where these conditions are provided. Species which hibernate in the egg stage (*Sminthurus viridis*, *Bourletiella hortensis*, *B. lutea*, etc.) attain enormous numbers when temperature and humidity favour hatching; the movement of the young Collembola is then influenced by humidity. Such was the case[3] of *Bourletiella hortensis*, Fitch., which swarmed over the mangold field during the early morning when the soil was moist, but later in the day moved below soil-level, except when near plants which they had damaged. In this latter case the point at which plants' juices exuded provided both food and favourable humidity, hence this species swarmed in such sites.

W. MALDWYN DAVIES.

University College of North Wales
(Memorial Buildings), Bangor,
June 20.

[1] NATURE, **129**, 830, June 4, 1932.
[2] Davies, W. M., *Brit. J. Exp. Biol.*, **6**, i. 79, Sept. 1928.
[3] Davies, W. M., *Bull. Ent. Soc.*, 17, 159; 1926: *J. Min. Agric.*, **32**, iv., July 1925.

The Rearing of *Hæmatopota pluvialis*, Linné (Cleg, Tabanidæ) under Controlled Experimental Conditions

DESPITE the potential or actual importance of blood-sucking insects in the transmission of pathogenic micro-organisms, investigation of the life-histories of the European species of the Tabanidæ, including that of the cleg, the most common of our palæarctic species, has been comparatively neglected. Hitherto the number of larval stages has not been ascertained in any European tabanid species, and for the rest this has been determined only in one bivoltine North American species[1] and in five trivoltine Indian species.[2]

In our experiments, which commenced in 1930, we have succeeded in inducing females previously fed on human or rabbit hosts to deposit typical tabanid egg-masses in the laboratory. In individual cases females have oviposited twice, the two acts of oviposition being separated by an interval during which a second

blood meal was taken. There is also evidence that a third oviposition may occur. The fact that two or more acts of oviposition can occur separated by intervals when another host is attacked, is of prime significance relative to the biological transmission of micro-organisms from one host to another.

On emerging from the eggs after an incubation period of about ten days, the first larval instars were isolated in a moist sand medium in small glass vials and reared to maturity under conditions identical for all. The number of ecdyses varied from 7 to 9, the last being that preceding pupation, and they were distributed over one or two years. Individuals reared from the same batch of eggs required either one or two years to complete their development, and it may be safely concluded that *H. pluvialis* is heterozygous for univoltine or demivoltine characters. This conclusion is corroborated by the results of a series of experimental rearings now being carried through at a constant temperature of 70° F. Whilst increased temperatures induced a decided increase in the initial rate of metabolism, as expressed in the more rapid growth of the early instars and decrease in the duration of the early stadia, they did not essentially alter the characteristic type of development. That differential development of palæarctic Tabanidæ resulting in life-histories extending over one or two years is not an unusual phenomenon, was abundantly evident in our investigations [3] of Canadian species, and appears to be genetic in its origin.

In order to obviate the risk of overlooking any individual ecdysis—which may readily occur in the case of the earlier ones—a series of measurements of a standard skeletal structure was made in each exuvium recovered. The paired tentorial rods of the head capsule were selected for this purpose and have proved invaluable in checking our observations. Counts of the number of pedunculate bodies in Graber's organ have also proved useful in this respect. Thus in *H. pluvialis* there are twice as many pedunculate bodies for any particular instar as the number which designates that instar. Contrary to what occurs in many other Tabanidæ, there is no elimination of pedunculate bodies to the exterior during larval development.

The detailed results of our investigations will be published later.

A. E. CAMERON.

Department of Zoology,
University of Edinburgh,
June 1.

[1] Schwardt, H. H., *Ann. Entom. Soc. Amer.*, **24**, 409-416; 1931.
[2] Issac, P. V., *Mem. Dept. Agr. India, Entom. Ser.*, **8**, 53-62; 1924. *Ibid.*, **8**, 93-109; 1925. *Ibid.*, **9**, 21-28; 1925.
[3] Cameron, A. E., *Bull. Ent. Res.*, **17**, 1-42; 1926.

Origin of Insects from Crustacea

WHILE agreeing with the substance of Dr. R. J. Tillyard's remarks on the above subject,[1] it may be pointed out that certain observations upon the development of the coxal styles of the Machilidæ are to be found in a paper by R. Heymons published so long ago as 1906. In this communication, entitled "Ueber die ersten Jügendformen von Machilis",[2] it is mentioned that the styles in association with the thoracic coxæ of *Machilis* are not present in the young stages, and, in fact, are only discernible when the insect is in its third stage of development. This agrees with Dr. Tillyard's observations in which he points out that, in the Australian *Allomachilis*, the coxal styles are wanting in the first and second instars, and that it is only in the later instars that these organs become evident.

Dr. Tillyard also mentions that these problematical structures are devoid of muscles, and this fact, together with his conclusion relative to their being little more than secondarily developed spurs, are in accordance with views previously expressed by F. Silvestri [3] and by R. E. Snodgrass.[4] The main points of Dr. Tillyard's letter, therefore, confirm the conclusions of those investigators mentioned.

A. D. IMMS.

Zoological Laboratory, Cambridge,
June 15.

[1] NATURE, **129**, 828, June 4, 1932.
[2] *Sitzgs. Gesellsch. naturforsch. Freunde*, Berlin, pp. 253-259.
[3] *Zool. Jahrb.*, **3**, Suppl. 6, pp. 773-806; 1905.
[4] *Smiths. Misc. Coll.*, **85**, No. 6, p. 115; 1931.

Implementiferous Deposits of East Anglia and the Lower Thames Valley

A CLOSE examination of the implement-containing deposits of the Lower Thames Valley has led us to realise that they are to be correlated with certain others in East Anglia. During the course of our investigations we have observed that the Boyn Hill or '100-ft.' terrace, which at Hornchurch is cut in the Kimmeridgic Chalky Boulder-clay (2nd glacial phase), and at Dartford attains a surface-level of 137 feet above O.D., contains no pene-contemporaneous hand-axes of greater age than that of the St. Acheul 1 period; whilst the coarse, and usually unstratified, melt-water gravels which rest upon the Coombe Rock include derived Early Mousterian (Levallois) implements and tortoise-cores, in addition to artefacts of earlier epochs.

Our researches prove that the deposits of the Taplow or '50-ft.' terrace, which at Acton reach a surface-level of 100 feet above O.D., were formed after the deposition of the Coombe Rock (3rd glacial phase) which overwhelmed the Early Mousterian (Levallois) factory-site at Baker's Hole, Northfleet. We have noted that (1) the base of the gravel underlying the brickearths of the Taplow terrace is composed (as at Slades Green and elsewhere) of a *remanié* formed from the Coombe Rock and its associated melt-water gravels; (2) the Coombe Rock has been truncated by the deposits of the Taplow terrace at Belmont Castle, and between Slades Green and Stone, and elsewhere; and recently one of us (J. P. T. B.) has discovered between Northfleet and Swanscombe the high and steep-angled cliff which has been cut through the Coombe Rock and Chalk and against which the Taplow deposits have been banked. Here, in the basal gravel underlying the brickearth of the Taplow terrace, we have located a horizon characterised by an abundance of pene-contemporaneous implements of Middle Mousterian age together with derived artefacts and mammalian remains.

During the early part of the succeeding period of elevation which followed the maximum of the Taplow submergence, fluviatile and sub-aerial loams, characterised by the shell *Helicella striata* (Müll.), were formed, which sealed in occupation-floors of the Aurignacian epoch containing flint implements and pottery fragments. The ensuing or 4th glacial phase is represented by stony hill-wash containing 'rafts' of Coombe Rock and/or by the 'trail'; the former may be studied at Grays and Swanscombe, whilst the latter is well developed at Belmont Castle and at Slades Green, where it caps the Taplow deposits. The 'trail' never overlies the Low or '25-ft.' terrace.

The results, both archæological and geological, that we are obtaining will be fully described in November next before the Society of Antiquaries of London: if our views are correct, it follows that no implementiferous deposits earlier than those of the second inter-glacial period of East Anglia are present within

the valley of the Lower Thames, and that these deposits were laid down from Clactonian 2/Acheulian times onwards.

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Confirmation of the Space-Group of Epsomite

ALTHOUGH orthorhombic magnesium sulphate heptahydrate (epsomite) has been the subject of two previous investigations,[1, 2] in neither case was a complete structure proposed. We commenced work on this substance in the hope of carrying the knowledge of its structure to a more complete stage. Due to unforeseen circumstances, however, the investigation has been interrupted, and it is uncertain when the study can be resumed. We have considered it of interest to report some of our results, since they agree with those already in the literature, and thus serve as a third check on the dimensions of the unit cell and on the space-group.

The crystals employed were small prisms having faces of the form {110} prominently developed. The apparatus consisted of a Shearer X-ray tube fitted with a copper target ($K_\alpha = 1{\cdot}54$ A.) and a Müller spectrograph.

The results obtained for the size of the unit cell and the number of molecules per cell compared with the data of Cardoso and of Westenbrink are as follows:

	Barnes and Hunter.	Cardoso.	Westenbrink.
a_0	11·94	11·91	11·89
b_0	12·03	12·02	12·01
c_0	$6{\cdot}86_5$	6·87	6·86
mol./cell	4	4	4

Oscillation photographs showed conclusively that {*h*00}, {0*k*0}, and {00*l*} are halved. This was based on the fact that reflections from the odd orders from 1 to 12, inclusive, for {*h*00} and {0*k*0}, and from 1 to 6, inclusive, for {00*l*} were missing. Higher orders than these were unattainable with the apparatus employed.

The only orthorhombic space-group with these halvings[3] is Q^4, which is that found by Cardoso and by Westenbrink. Since Q^4 is in the bisphenoidal class, the X-ray data lead to the same conclusion as to crystal class as that reached by the methods of crystallography.

Our results for the dimensions of the unit cell agree more closely with those found by Cardoso, which are those selected by Wyckoff for quotation in the second edition of the "Structure of Crystals". They were obtained experimentally from rotation photographs about each of the three axes. Westenbrink calculated the primitive translations along the *a* and *c* axes by assuming the crystallographic axial ratio ($a : b : c = 0{\cdot}9901 : 1 : 0{\cdot}5709$)[4] to be correct and measuring $\theta/2$ accurately for the second order reflection from {110}.

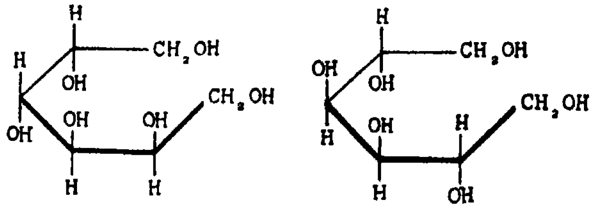
This work was carried out during the tenure by one of us (R. G. H.) of a bursary from the National Research Council of Canada.

WILLIAM H. BARNES.
R. G. HUNTER.
Departments of Chemistry and of Physics,
McGill University, Montreal,
May 31.

[1] Cardoso, *Z. Krist.*, **63**, 19; 1926.
[2] Westenbrink, *Proc. Acad. Sci. Amsterdam*, **29**, 1223; 1926.
[3] Astbury and Yardley, *Trans. Roy. Soc.*, A, **224**, 230-236; 1924.
[4] Groth, "Chemische Krystallographie", vol. 2, p. 428; 1908.

An X-Ray Study of Mannitol, Dulcitol, and Mannose

IN connexion with a paper under the above title,[1] Prof. W. N. Haworth has pointed out that the actual space formulæ of d-mannitol and i-dulcitol are:



d-Mannitol. i-Dulcitol.

On uncoiling these to give zigzag or slightly spiral chains of the nature suggested by the dimensions of the unit cells, the projections of the chains on a plane perpendicular to the plane of the zigzag become

```
         OH H  H OH                   OH OH H  H
         |  |  |  |                   |  |  |  |
HO·CH₂—C—C—C—C—CH₂OH       HO·CH₂—C—C—C—C—CH₂OH
         |  |  |  |                   |  |  |  |
         H OH OH H                    H  H OH OH
          d-Mannitol.                  i-Dulcitol.
```

This involves the alteration in position of two hydroxyl groups per molecule in the models illustrated in the paper. These alterations do not affect materially the fundamental features of the respective unit cells, but they introduce interesting possibilities which will be discussed in a separate paper.

I am very much indebted to Prof. Haworth for this correction.

THORA C. MARWICK.
Textile Physics Laboratory,
The University, Leeds,
June 15.

[1] *Proc. Roy. Soc.*, A, **131**, 621; 1931.

Removal of Added Nitrogen from Grassland Soils

WORK has been in progress in these laboratories since 1929 on the available nitrogen of grassland soils, with especial reference to the soil ammonia, which in these soils preponderates in quantity and possibly also in importance over the nitrate. The work as a whole will not be completed for some time, but information has already been obtained which may be useful to other workers on the nitrogenous manuring of grassland.

An outstanding result is the speed with which nitrogen added to grassland soils, whether as ammonia or as nitrate, is removed. Observations made here and elsewhere on the rapid falling-off in the response to a single dressing of nitrogen on repeatedly mown plots have suggested that the added nitrogen could not remain for long in the soil, but its rate of removal by vigorously growing herbage has proved unexpectedly high.

A convenient measure of rate of removal is the interval required for three-quarters of the added nitrogen to disappear from the soil. With an early spring application (Feb. 18, 1930) of sulphate of ammonia on pasture, this interval was three weeks, and about the same time was required for a late autumn dressing (Dec. 6, 1929); these dressings were applied when the plant was probably almost dormant. For a heavy dressing of sulphate of ammonia applied in mid-spring, when vigorous growth was beginning, the interval required for disappearance of three-fourths of the added nitrogen was only seven days (Park Grass, meadow hay, 3¾ cwt. sulphate of ammonia per acre applied March 27, 1931). In late

spring (April 26, 1932), when growth was already vigorous, the corresponding interval for the same rate of application was two days. There was no appreciable accumulation of nitrate in the soil after any of these applications of sulphate of ammonia.

With nitrate of soda, as might have been expected, the disappearance of the added nitrogen was still more rapid: three-quarters of the nitrate added in an equivalent dressing (5 cwt.) on Park Grass had disappeared in about three days in mid-spring, and in late spring less than two days were required.

Without attempting to discuss these results—in particular, the question of what proportion of the nitrogen which disappears is obtained by the plant—they suggest certain practical applications. Evidently the short period during which added nitrogen remains in grassland soils greatly reduces the risk of loss by leaching-out of nitrates, except possibly during the winter months. Where grass is being repeatedly removed, as by mowing or grazing, the direct effect of added nitrogen might be expected to be of brief duration, since even if it is added as ammonia it does not remain long as a 'reserve' in the soil. This very rapid removal of added ammonia by vigorously growing grass—almost as rapid as the removal of nitrate, and a matter of days only—may be taken as a strong indication that in the soil, as well as in culture solutions, grass is able to assimilate ammonia directly without the need for previous nitrification. Further experiments are being made to examine this question.

H. L. Richardson.

Chemistry Department,
Rothamsted Experimental Station,
Harpenden, Herts, May 27.

Chain Reactions in Enzymatic Catalysis

Prof. J. B. S. Haldane has recently criticised the chain reaction theory [1] in the form in which it has been applied by Haber and Willstätter to biochemical processes.[2] One can scarcely deny the validity of Prof. Haldane's arguments, but his criticism is directed not so much against the chain reaction theory itself as against the particular chain *mechanism* proposed by Haber and Willstätter.

It has been suggested that a more satisfactory explanation of the experimental observations may be given by the *energy chain* mechanism.[3] According to this view, which is due to Christiansen,[4] molecules are capable of existing in an activated condition which they normally assume prior to reacting, and the chains are propagated by the transfer of energy from the products of an exothermal reaction to one of the reactants, which is thereby activated and in turn caused to react, *et seq.*

Prof. Willstätter has raised the objection that the activated molecules would at once lose their energy in collisions with the surrounding water molecules. This objection, which at first appears to be conclusive, loses much of its weight in the light of experimental evidence obtained by Gibson and Hinshelwood,[5] who have shown that the transfer of energy from an activated molecule is a *specific* process, so that the transfer of energy from organic molecules to water molecules may be taken as being comparatively slight.

Further evidence as to the specificity of energy-transfer has come from Perrin's work on fluorescence.[6] The simple observation that fluorescein fluoresces in aqueous solution shows that the activated fluorescein molecules do not easily give up their energy to the surrounding water molecules, but emit it more readily in the form of light.

As Prof. Haldane has pointed out in this connexion, in most intracellular oxidations much of the energy is not liberated directly as heat but is used up in coupled reactions. This is not easily explained on the Haber and Willstätter mechanism, but the idea of the specific transfer of vibrational energy from the products of an exothermal reaction to other molecules in the system makes these coupled reactions readily intelligible.

The Christiansen energy-chain also seems to give a more satisfactory explanation of the specificity of inhibition in enzyme reactions. On this view, inhibition, in so far as it may be attributed to the breaking of reaction chains, is due to the transfer of energy from an activated link-member of the chain to an inhibitor molecule, and this process should also be in some degree specific.

Derek Richter.

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South Parks Road,
Oxford.

[1] Nature, **129**, 61, July 9, 1932.
[2] Ber., **64**, 2844; 1931.
[3] *Biochem. J.*, in press.
[4] *J. Phys. Chem.*, **28**, 145; 1924.
[5] *Proc. Roy. Soc.*, A, **119**, 605; 1928.
[6] *C.R. Ac. Sci.*, **184**, 1097; 1927.

An Unpublished Letter of Lavoisier

The Science Library at Clifton College possesses an autograph letter of Lavoisier that I believe to be unpublished. Though it is of no scientific importance, any relic of so great a man deserves to be placed on record, and the following transcription may thus be of interest:

Je suis oblige mon cher Parent par le decret relatif a lemprunt forcé de presenter letat de mes possessions et l'evaluation du revenu doit etre faitte dapres la matrice des Rolles. Je vous serai en consequence tres oblige de faire faire dans chacune des paroisses ou je possede des biens un extrait de la matrice du rolle pour coqui me concerne avec l'evaluation du revenu. La loi ne donne que quinze jours pour faire les declarations aussy il ny a pas de tems a perdre. Vous concevis que le montant des impositions que je paye ne remplisoit pas mon objet, car en general limpost dans presques toutes les communautés est superieur a 'evaluation et puisque la loi a pris pour base cette evaluation il est juste que je proffite du benefice quelle m accorde.

Je ne scais si les haricots ont manque de vos cotes comme aux environs de Paris. Dans letat de denuement ou nous serons cet hiver a Paris pour les comestibles, il nous serait fort important que vous nous envoyassiez les haricots de redevance qui me sont dus.

Il y a bien long tems que je n'ay recu de vos nouvelles mais je concois que vous devez etre tres occupe relativement aux requisitions qui ont ete faittes.

Je vous renouvelle mon cher Parent lassurance de mon inviolable attachement.

Le 18 jt 1793 lan 2e de la republique une et indivisible.

Lavoisier.

The letter is addressed to Citoyen Parisis fils, at Villers-Cotterets, where Lavoisier's paternal ancestors were established as early as the beginning of the seventeenth century. Charles-Antoine Parisis was a distant relative of Lavoisier by marriage, having married Antoinette-Françoise Lavoisier, second cousin of Lavoisier's father, Jean-Antoine [Grimaux, *Lavoisier*, Paris, 1888, p. 326].

E. J. Holmyard.

Clifton College, Bristol,
June 5.

Inheritance of Milking Capacity

Now that Mr. Edwards[1] has made the first point of his original letter clear, his criticism is one which has already been suggested, and discussed, by myself. If this criticism were invariably valid, it should also hold good as regards butter-fat yield. In the case of Mr. Madsen's work the argument may be valid, but as I believe his butter-fat figures were calculated on the averages of percentages, this may explain a similarity in the milk and butter-fat figures. A truer indication may be obtained from the work of Robison and myself, to which Mr. Edwards has already made reference, where, despite what Mr. Edwards calls the phenotypic selection of the sires, the butter-fat correlation of granddaughters to their paternal grandsire is the same as to the maternal grandsire.

With regards to points (2) and (3), Mr. Edwards has shifted the grounds of his argument considerably. In one respect he remains consistent, in that he persists in confusing correlations based on genotype with those based on phenotype. Since he still misunderstands the original statements of Mr. Madsen, I feel that little good can result from a further debate upon these points.

As to point (4), I maintain that I was justified in challenging Mr. Edwards as to the accuracy of his calculation that the results obtained by Mr. Madsen might once in ten times be due to chance. I repeat that one in twenty expresses more accurately the possibility of Mr. Madsen's results being obtained by chance. Tables of the normal curve, which, as Dr. Wishart[2] admits, are for such large samples sufficiently accurate, show that a deviation of $-1 \cdot 64\sigma$ leaves only one-twentieth of the area to the left of that point. The fact that there is also a second twentieth to the *right* of the point $+1 \cdot 64\sigma$ is irrelevant, since positive deviations, however great, could not be cited in support of sex-linkage. The distinction is a simple one, though frequently overlooked. The point has been fully explained by Dr. R. A. Fisher.[3]

It is now four years since the facts first suggested to me the possibility that the hereditary transmission of milking capacity might be in part conditioned by sex-linked genes. Since that time, I and others have been pursuing this subject along various lines, and we have not yet been able to find a valid reason for jettisoning this hypothesis, which appears to be not only warranted by the results obtained by ourselves and others, but also explains many of the practical difficulties of breeders. Neither I nor my colleagues, however, are wedded to this hypothesis, but we still await criticism which might compel us to modify our views.

A. D. BUCHANAN SMITH.

Institute of Animal Genetics,
University of Edinburgh.

[1] NATURE, 129, 867, June 11, 1932.
[2] NATURE, 129, 868, June 11, 1932.
[3] Fisher, R. A., "Statistical Methods for Research Workers", 3rd edition, p. 45.

Polypharyngeal Planarians

AMONG a dozen specimens of the planarian, *Polycelis cornuta* Johnson, collected in August 1931 from a small pond at Liss in Hampshire, I observed one specimen with a well-developed double pharynx. I revisited this pond in March of this year and was able to collect several hundred specimens of the same planarian. In this pond *Polycelis cornuta* constituted more than 90 per cent of the planarian population, *Polycelis nigra* and *Dendrocœlum lacteum* being present in small numbers. On examining these specimens of *Polycelis cornuta*, one was again found with a double pharynx.

Polypharyngeal planarians have frequently been recorded from various districts on the Continent, but, so far as I am aware, this is the first time that this type of abnormality has been recorded from the British Isles. Previous records of polypharyngeal planarians have usually been from mountainous districts, but Thienemann[1] has recorded finding one specimen of a tripharyngeal *Polycelis cornuta* from among a hundred specimens collected from springs in Holstein. The dipharyngeal forms are evidently not common, but, from the fact that they have been found fairly easily in two collections made at different times, it may be assumed that this abnormality is established in the race living in this particular pond. *Polycelis cornuta* is a fairly common species in Britain and the existence of the double pharynx is quite obvious on examination, even with a simple lens, so that it is unlikely that these abnormal forms would have escaped notice.

The pond in which the dipharyngeal forms occurred is a small one, about five yards in diameter and less than one foot deep. It is on the slope of a hill and is supplied by a spring draining out of the soil. The temperature of the water of the pond in March 1932 was 6° C., and this temperature corresponded with that of the local streams. The temperature of deep springs from the chalk in the same district at the same time was 9·5° C. It can be assumed, therefore, that the water supply of this pond is not from a deep spring, which would maintain an even temperature of the water throughout the year. The temperature of the water in the pond at the time of my visit in March appears to show that it varies with that of the air, in the same way as other ponds and streams supplied by surface drainage.

JOHN H. LOCHHEAD.

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June 1.

[1] *Zool. Anz.*, 53, 118; 1921.

Trochus niloticus, Linn. in Andaman Waters

DR. YONGE in "A Year on the Great Barrier Reef" (Putnam: 1930) states that certain animals like the horse-hoof clam spawn "at the peak of summer"; others like *Trochus niloticus* "during the entire winter".

My observations on the bionomics of *T. niloticus* on the east coast of the Andaman Sea reveal (1) that this species grows during the monsoon and 'winter' months, that is, July to March, and (2) that it starts spawning about the middle of the summer months, that is, April.

The temperature of the Andaman Sea has two definite rises and two falls in a year.[1] The first rise starts in February, to reach a climax in April-May, before the outbreak of the south-west monsoon; there is a fall during the monsoon. The second rise starts in July-August, to reach its highest point in October, before the north-east monsoon; and finally, the second fall begins in November. The first rise of temperature, that is, the April one, reaches a higher degree than the second, the October one. As remarked above, *T. niloticus* starts spawning in April, and it appears, therefore, that in the Andaman waters this mollusc has a minimum temperature above which alone it would spawn. This observation emphasises the idea that the marine invertebrates in tropical waters do not breed haphazardly but with a similar regularity to that observed in temperate waters.

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Zoological Survey of India,
Calcutta, May 16.

[1] R. B. S. Sewell, *Mem. Asiatic Soc. Bengal*, vol. 9.

Research Items

Yavapai Shamans.—In the course of a study of the south-eastern Yavapai of Central Arizona, otherwise known as the Mohave-Apache or Yuma-Apache (*Univ. Cal. Pub. Amer. Arch. Eth.*, vol. 29, No. 3), Mr. E. W. Gifford has recorded the methods and system of training of the shaman or medicine man of these people. Shamans' visions come in trances rather than in dreams, and his power is acquired while in a trance. A trance was usually the first intimation that a person was about to become a shaman. In it the god Amchitapuku talked to the novice, taught him songs, told him what to do and say, and how to help the sick. By the same means he revealed to the shaman whether a sick person would live or die. All treatment of the sick was at night. The shaman did not blow on the affected part, nor froth saliva; he sang over the patient and, while singing, saw a flash of lightning in the afflicted part. He then cut a cross there with a flake of glass and sucked the cut, finally producing from his mouth a worm-like object which he displayed to the patient as the cause of his illness. Four eagle feathers, a gourd, and a bull-roarer were employed in healing. Each of these feathers was stuck upright in a cardinal direction near the patient, and while the shaman was singing he touched the seat of the pain with one of them. Sometimes the bull-roarer was swung round as the shaman entered the patient's house. He thus communed with the goddess Widapokwi, and if she so advised him, he whirled it while singing. A sucking shaman was not blamed if a patient died, nor was he blamed for the death of other persons. If, however, a patient died, the shaman returned to the relatives all the property they might have given him.

Decorative Art in Oceania.—In a study of the decorative designs of Oceania based on material in the United States National Museum (*Proc. U.S. Nat. Mus.*, vol. 79, Art. 30), Mr. Herbert W. Krieger distinguishes six distinct geographical design-areas as showing differences in art forms and application of design. They are: Tonga-Samoa, New Zealand, Raratonga-Tubuai-Tahiti, Manihiki, the Marquesas, and the Hawaiian Islands. Tonga-Samoa is characterised by the use of straight lines, zigzags, and a derivative, the dentated line. There are some delineations of animals and men. In the New Zealand area curved lines with a pronounced tendency towards spirals show a clear reaction with Fijian and Papuan types of etched and painted designs. Stylistic art patterns are fixed and standardised. In the Manihiki area sculptures in wood are for the most part unknown; but small plaques with incrustations of shell arranged in symmetrical form are found. The Marquesan designs are more conventional. Two types of human face, strongly stylised, occur. In the Hawaiian area straight lines are decorated with nodes, zigzags, or angles; straight lines, parallel or crossed, form lozenge-shaped designs reinforced with dots or curved lines. In the Raratonga-Tahiti group we find designs derived from anthropomorphic models. All objects appear to have a religious significance. In an area so large as Polynesia and so heterogeneous there are few elements common to the whole area; but as one passes from west to east there is a developmental sequence in the plastic art.

Seasonal Colour-Changes in Mammals.—Apart from that major type of colour-change, from summer coat to winter white, which characterises certain mammals of arctic or subarctic origin, a well-known seasonal change in tint takes place in the common red squirrel, in which the gradual bleaching is attributed to light. Capt. Guy Dollman recalls Andersen's observations on the Indian rufous horseshoe-bat, where a progressive bleaching could not be due to sunlight, and parallels that case by a similar change in the African flying 'squirrel' or scaly-tail, *Anomalurus jacksoni* (*Proc. Linn. Soc. London*, 1931–32, pt. 3, p. 68). Three of four specimens from Uganda are redder than the type, and since light cannot be the cause of the bleaching in these nocturnal animals, it is suggested that the change may be due to oxidation of the dark pigment granules to a paler colour. Since, however, the formation of the dark colouring matter or melanin is said to be due to the action of molecular oxygen or of a specific oxidising agent in the cell, the subsequent reduction of melanin by the same agent seems unlikely, and we suggest hypothetically that the cause may be looked for in another agent to which even the nocturnal mammals are subject, namely, heat. The suggestion is based on the fact that experiment has shown that heat has a restraining effect on the deposition of pigment; although it may be that when the pigment is deposited, heat can no longer affect it. The possibility of the influence of heat on fixed pigment, however, is worth keeping in mind and testing.

Myxosporidia from Indian Fishes.—Dr. H. Ray, of the University of Calcutta, who is engaged in studying the myxosporidia occurring in fishes in Bengal, has sent NATURE a letter upon this subject, but lack of space prevents its publication in full. Of such sporozoa, only two species of *Myxobolus* and one of *Sphærospora* have previously been recorded from Indian fishes. Dr. Ray has found nine species of fish infected. The parasites belong to the genera *Ceratomyxa*, *Chloromyxum*, *Myxidium*, and *Myxobolus*. Several of the species observed are new to science, and accounts of these will be published at an early date. A species of *Ceratomyxa* was found to be fatal to *Gobioides rubicundus* under laboratory conditions; almost every organ of the body in these fishes became infected. Dr. Ray thinks that the possibility of rapid spread and serious effects of myxosporidian infections in the somewhat unnatural conditions of aquaria should not be lost sight of when investigation into occasional heavy mortality of the fish there is undertaken. He is at present studying this question.

Dominance and Modifying Factors in Cotton.—The crinkled dwarf mutation from Sea Island cotton, described by Dr. S. C. Harland, has recently been the subject of further investigation (*J. Genetics*, vol. 25, No. 3). He finds it to be a complete recessive in crosses with the type from which it arose, but that its recessiveness is incomplete in crosses with other members of the Peruvian group. When Upland cotton is crossed with crinkled dwarf, the F_1 is intermediate and the F_2 shows an unclassifiable series from normal to more extreme crinkled. The F_1 back-crossed repeatedly to Upland shows increasing dominance of normal, and in the F_2 from the first back-cross one family showed reversed dominance, 3 crinkled : 1 normal. These and other facts are discussed in the light of Fisher's theory of dominance, and it is concluded that while the genetic behaviour favours Fisher's theory, yet there are difficulties in accounting for the distribution of genes modifying dominance, since all the Peruvian types appear to be homozygous for such genes. The necessary assumption to account for this, namely, that the original normal population has been replaced by normals descended from heterozygotes, appears improbable.

In a further contribution, Dr. Harland gives an account of chlorophyll deficiency occurring in hybrids between Upland and Peruvian cotton and the Polynesian *Gossypium tomentosum.* Three independent pairs of factors are involved. The chlorophyll-deficient class was found to show a range from completely lethal to fully viable, which is interpreted as due to modifying factors. Mr. J. B. Hutchinson also contributes to this series of cotton studies by describing a semi-sterile type called 'crumpled' which originated in a cross between *G. Nanking* var. *soudanensis* and *G. arboreum* var. *sanguinea.* It is found to be due to two complementary factors the distribution of which differs from strain to strain in Asiatic cottons. One of these factors has been found in two strains of Sudan cotton and the other in 17 varieties belonging to five Asiatic species. A number of modifying factors has also been found here.

Bacterial Canker in Plum Trees.—A canker of plum trees which produces lesions on the stem, associated with rolled and yellowish leaves in spring which later die or wither, has been described by Mr. H. Wormald (*J. Pom. Hort. Sci.*, **9**, No. 4, pp. 239-256, Dec. 1931). Various fungi are found on the lesions during summer, and some of these have occasionally been reported as the actual causes of the malady. The author of the present work studied the appearance of symptoms throughout the year and found that the cankers in spring were full of cells containing bacteria. He isolated an organism which, upon re-inoculation in spring, produced typical cankers which later became the home of the fungi. The bacterium was the real cause; the fungi were quite secondary in their appearance. *Pseudomonas mors-prunorum* is the name suggested for the new organism. Methods of control are being tried, but no definite recommendations are given.

Solar Radiation at Tokyo.—Regular observations of the intensity of the solar radiation are being made at the Central Meteorological Observatory at Tokyo by means of a self-recording Moll-Gorczynski actinometer. The first seven quarterly actinometric bulletins giving hourly values of the radiation, beginning with the figures for Jan. 21, 1930, have been issued. The introduction, of which there is an English translation, describes the methods of observation. The radiation has to pass through a quartz plate 2 mm. thick before reaching the thermopile of the actinometer. Every day when the weather permits, the actinometer is calibrated with the aid of an Ångström compensating pyrheliometer. After the record has been reduced to the angstrom scale it is converted to the Smithsonian scale. The hourly values of radiation for each day in gram calories per sq. cm. per minute are set out in tables covering single months, and a weather diary for each day is given, the international weather symbols being employed to economise space. Various subsidiary tables have been added, which include figures for the mass of air traversed by the sun's rays and the coefficient of turbidity. This should prove to be a series of publications of importance to those workers studying problems connected with the heat-balance of the earth, for the frequent checks on the accuracy of the observations are likely to ensure a homogeneous and reliable record, of which there are all too few.

High Velocity Positive Ions.—Drs. J. D. Cockcroft and E. T. S. Walton have published a description of the high potential generator which has been used now with such spectacular results (*Proc. Roy. Soc.*, June). The method used consists essentially in the multiplication and rectification of the voltage of a transformer by an arrangement of valves and condensers, the insulation of the high tension system being distributed over a number of units. The rectifier system is of novel design, consisting of four glass cylinders placed end to end in the form of a tower twelve feet high, and containing suitable electrodes and hot filaments and exhausted continuously; with its four condensers, a potential of more than 700 kv. has been obtained, which is steady to within a few per cent. The method of making vacuum joints which has been used, although crude, seems to be efficient, when used in conjunction with pumps of high speed. It consists simply in putting two surfaces together, working a plastic substance round the joint with the fingers, and finally rubbing over the surface with tap-grease to seal small residual holes. For the earlier work, commercial plasticene was used with satisfactory results, but in the final apparatus this was replaced by a special low vapour pressure putty supplied by the Metropolitan-Vickers Electrical Co. The pumps used also worked with a low vapour pressure oil in place of mercury, thus making the use of liquid air traps unnecessary. The paper is illustrated by a photograph which shows the apparatus set up.

Polarisation of Electrons.—The fact that an electron can be described as having a magnetic moment and an axis of spin carries with it the implication that it should be possible to polarise a beam of electrons. Certain types of experiments are ruled out by the uncertainty principle, but it has been shown by Mott that it should be feasible to carry out the analogue of the old optical experiment of producing and detecting polarisation by successive reflection from two inclined mirrors, under rather stringent conditions. Mott's criteria have been fairly closely observed in experiments described by E. G. Dymond (*Proc. Roy. Soc.*, June). Rather fast electrons were used, and, to avoid multiple scattering, were projected on to two targets of thin gold foil. Many complications were encountered, and the experiment proved to be one of much difficulty, largely on account of the extreme feebleness of the twice scattered beam, but the conclusion is reached that a slight polarisation, of the order of one per cent, was present. Actually a polarisation of ten per cent was predicted by Mott's theory, so that an interesting discrepancy still persists. G. O. Langstroth (l.c.) has reported a negative result in an attempt to polarise electrons by successive reflection from two massive tungsten targets, which provides a problem less difficult than Dymond's experimentally, but considerably more complicated in interpretation.

Theory of Conical Loud Speakers.—Dr. N. W. McLachlan, in a paper read to the Physical Society on March 4, describes the symmetrical modes of vibration of truncated conical shells with special reference to loud speaker diaphragms. There are two salient types of vibration pertaining to these shells. First, radial modes as in a bell, and secondly, symmetrical modes as in a disc. The author discusses the latter type only, as it is this kind of vibration which is of importance in connexion with loud speakers of the hornless type. As the problem stands at present, it appears that to get a solution embodying the two radii, the apical angle, the thickness of the shell and Poisson's ratio for various edge conditions, a team attack by several investigators would be required. The present paper gives an account of a number of experiments carried out by the author. He used paper, glass, and aluminium shells. He found that the modes crowd together as compared with the segregation which occurs in the case of a disc. With thick glass or aluminium of comparatively low loss, the nodal frequencies are very clearly defined peaks. In the case of paper cones driven by coils of small mass, the peaks disappear

and the nodal region is indicated by a broad rounded contour. The influence of thickness, apical angle, and the mass of the driving coil are considered. Vibrations of the air column within the shell and the general requirements for loud speaker diaphragms are discussed. In a letter to NATURE (129, 202, Feb. 6, 1932) he reported the occurrence of resonances to the air column in the shell.

Television in Relation to Seeing.—"The Eye, as a Link in the Television Chain", formed the subject of a recent paper by Mr. W. D. Wright before the Television Society. Persistence of vision, an important factor in the cinema, is possibly even more influential in television. The critical frequency increases with intensity. The desired increase in the brightness of television pictures (at present somewhat faint) would therefore increase the numbers of scans per second necessary to avoid objectionable flicker. A light surround to the picture accentuates the sensitiveness of the eye to flicker and should be avoided. At present a speed of 20 pictures per second seems a fair compromise between the desirable and the feasible. 'Irregular scanning' helps in some measure to diminish flicker. The roving and mainly horizontal movements of the eye, and likewise its occasional blinking, tend to produce a rather troublesome stroboscopic effect. On the whole, the advantage in this respect seems to lie with pictures scanned horizontally. The present limitation in size of picture is admittedly a drawback. The author asks, "Is it really possible to obtain lasting enjoyment and entertainment from a picture which is, say, only three or four inches square?" The minuteness of the figures, coupled with the short focusing point for the eye, give rise to a sense of unreality. The brightness of the picture should be as high as possible; 5 candles per sq. ft. would be very satisfactory, 0·5 good, and 0·05 passable. Various factors that may occasion deficiency in contrast or distortion are mentioned. The conditions for a television picture in colour are considered too complex to justify detailed discussion.

Astronomical Topics

Comets.—Some doubt has been thrown on the existence of comet 1932 *h* (Schmitt) from the fact that Prof. Schorr at Bergedorf, Prof. G. Struve at Neubabelsberg, and Dr. W. H. Steavenson at Norwood have failed to find it; some positions that were thought to belong to it really belong to Newman's comet. The evidence for its existence is a photographic position by Schmitt on June 25, 99^{sec} east and 12′ north of Newman's, and a statement that Schmitt confirmed it on June 29. Continuation of the ephemeris of Newman for 0^h:

	R.A.	N. Decl.
July 16	15^h $0{\cdot}7^m$	21° 13′
20	14 57·4	22 36
24	14 54·9	23 51
28	14 53·2	24 58
Aug. 1	14 52·4	25 57

Dr. Bobone has computed the following elements of the comet 1932 *g*, discovered by Mr. Geddes in New Zealand; presumably they are based on observations made at Cordoba (Argentine) (*U.A.I. Circ.*, No. 390):

$$\begin{array}{ll} T & 1932 \text{ Oct. } 26{\cdot}95 \text{ U.T.} \\ \omega & \left.\begin{array}{l} 356^\circ\ 32' \\ 222\ \ 56 \\ 122\ \ 12 \end{array}\right\} 1932{\cdot}0 \\ \Omega & \\ i & \\ q & 1{\cdot}913 \end{array}$$

The axis of this orbit lies very near the ecliptic, suggesting possible periodicity, but there is no close resemblance to any previous comet. The comet will be well placed for southern observers for the next two months; it will then pass nearly behind the sun. It should be visible in Europe as a morning object about the end of the year. *Harvard Card* 224 gives the following position obtained at Cordoba:

June 27·0366 U.T., R.A. (1932·0) 10^h 55^m $16{\cdot}7^s$, S. Decl. 30° 53′ 25″, Mag. 9.

The Reinmuth Planet, 1932 *H.A.*—Dr. G. Stracke, of the Berlin Rechen-Institut, who was the first to deduce a good orbit of this remarkable planet, contributes an article on it to *Astr. Nach.* 5878; an accurately drawn diagram shows its orbit and that of the Delporte planet found in March, in relation to the orbits of Venus, the earth, and Mars. The only uncertainty now is the exact period; Stracke finds 1·8395 years, while Miss Covey and Dr. Wyse make it two months longer. Prof. H. E. Wood writes that he observed the planet from Johannesburg, though he has not yet sent positions; when they arrive, they will help in determining the distance from the earth and consequently the period; they will be about 2′ away from simultaneous northern positions in consequence of the proximity to the earth. Dr. Stracke brings out some singularities in the planet's motion; it was in opposition on April 24, and in conjunction with the sun only six weeks later. At discovery it was retrograding more than a degree per day, which instantly attracted attention; but if it had been discovered a week earlier its motion would have been less abnormal, and it might have passed as one of the usual host of minor planets, which did not seem to require close attention. On May 15 it was moving nearly 7° per day, a speed only exceeded by a few comets.

The latest observation now to hand was made by Prof. van Biesbroeck at Yerkes on May 15; it is possible that it may have been followed longer at Johannesburg. Attempts will be made to re-observe it as a morning object in August, but it will be a long way off and therefore faint.

Leyden Observatory.—An interesting feature of the report of the director of Leyden Observatory, Prof. W. de Sitter, is a description of the expedition of Dr. Hins and Mr. van Herk to an equatorial station in Kenya Colony to observe the azimuths of fundamental stars. The chosen station is 9000 feet high, and three-quarters of a mile south of the equator. It is well known that there are differences of declination in the standard catalogues of fundamental stars amounting to considerable fractions of a second; these arise from uncertainties in the correction for refraction. Several years ago Prof. de Sitter proposed the plan of making observations of the azimuths of stars from a station on the equator, thus getting rid of the correction for refraction. He sent Mr. Sanders with a small instrument to make trial observations at a station in the Portuguese Congo. The results were encouraging, and a more accurate instrument has been constructed by Messrs. Cooke, Troughton, and Simms, specially for the present expedition; it is reversible, and observations are made in both positions of the instrument. Stars near the equator appear to move vertically; those farther away have a slow motion in azimuth. An azimuth mark was erected 300 metres from the instrument, to check the zero point. Observations were begun on Nov. 30, and 148 complete observations were made by Dec. 31.

National Physical Laboratory, Teddington

Inspection by the General Board

ON Tuesday, June 28, the General Board of the National Physical Laboratory made its annual inspection of the Laboratory. A large number of visitors, including members of scientific and technical institutions, government departments, and industrial organisations, were present, and were received by Sir Frederick Gowland Hopkins, president of the Royal Society, chairman of the Board, Sir Richard Glazebrook, chairman of the Executive Committee, and the director, Sir Joseph Petavel.

In the Duplex Wind Tunnel of the Aerodynamics Department, tests were in progress on a model of a large four-engined monoplane, complete with airscrews, to determine the rolling and yawing moments at various angles of yaw and at various angles of the controls. The aim of the tests is to explore the efficiency and general characteristics of the control surfaces with and without the airscrews in operation, and to investigate the efficiency of the overall design. For this type of work a number of small gear-boxes of special design have been constructed, so that as many as six separate airscrews can be operated at once from a single electric motor situated in the fuselage of a model.

Apparatus for tests on the thrust and torque of model high-pitch airscrews was also on view. In consequence of the high speeds now required of aircraft, there has been a demand for airscrews of this type. The tests are expected to provide data both for these designs and for comparison with theory. An interesting feature of the apparatus is the three-phase motor constructed in the Laboratory for driving the screw shaft. Though of dimensions so small that it produces no appreciable interference with the airstream when mounted behind an airscrew of three feet diameter, the motor is capable of delivering 12 brake horse power for extended periods.

For purposes of demonstration, the aerodynamic balance for use in the Compressed Air Tunnel, together with the accessory electrical indicating apparatus, was exhibited. The balance consists essentially of a braced ring frame, in the centre of which the model is rigidly held. The frame can oscillate about three parallel axes, the change from one axis to another being effected electrically from outside the tunnel. From measurements of the moments about the three axes, one of which passes through the centre of gravity of the model, the lift and drag can be computed. A single set of electromagnetic coils, arranged on the principle of the Kelvin current balance and mounted at the top of the frame, suffices to measure the couple about each axis. The stability and sensitivity of the balance can be varied by electromagnets situated at the bottom of the ring frame. The whole of the electrical apparatus can be controlled from outside the tunnel.

An improved means of visualising airflow was demonstrated in the department. The method adopted is a modification of the one shown last year, when airflow was rendered visible by the shadow bands produced when air heated by thin wires was suitably illuminated. In the present method, the wires are replaced by a spark gap in which high frequency sparks are produced. The shadows in this case take the form of a series of semi-opaque 'dots'. By stroboscopic methods it is possible to isolate any given 'dot', the motion of which can then be observed visually or from photographic records. The method is being used in an attempt to determine the nature of turbulent flow in air.

The Engineering Department has given considerable assistance to the British Standards Institution in the design, standardisation, and testing of lifting gear components. Specimen links and hooks, etc., before and after test, were exhibited. On behalf of the Home Office, the department has undertaken investigations into the effect of service on the pitch of calibrated chains, and the effect of heat treatment on threaded parts of cranes and shackles. Special machines designed and constructed in the department for this work were demonstrated. In the chain tests, the chain is driven under conditions closely approximating to those obtaining in block and tackle. The effect of periodic heat treatment is being studied. In the case of threaded shackles and swivels, the machine applies repeated lifts to the specimens under test, the degree of impact being made to resemble closely conditions existing in a 30 cwt. crane.

In connexion with an investigation for the Lubrication Research Committee, experiments were in progress on journal bearings to determine the variation of the coefficient of friction with oil viscosity, load, speed, and clearance, and the effects of speed and clearance on the seizing temperature. These problems have a special application to motor and aircraft engines, and special machines have been constructed for the work. The experiments tend to show that lighter oils than usual may be used with safety. It is found that an increase in the clearance from two or four thousandths of an inch to sixteen thousandths leads to an appreciable decrease in the seizing temperature.

An investigation has been commenced of the way in which stress varies with strain during impact tests of materials. A machine of the swinging hammer type is employed, and the well-known piezo-electric properties of quartz crystals are utilised to record the changes of stress during impact by means of a cathode ray oscillograph. The time scale on the record is obtained by utilising the change in voltage when a condenser is discharged through a resistance. A method of measuring the strain electrically is being developed.

Of interest also were 'cupping' tests on sheet metal. Information is needed regarding the properties of sheet metal used for cold pressing operations. Various cupping tests were shown, and in particular one in which the metal is deformed by oil pressure until fracture occurs. The method can be used to give a fair indication of the tensile strength of the material. The apparatus is fitted with an autographic method of recording load and distension.

In the Metallurgy Department, research is in progress on the constitution of certain magnesium alloys with the view of obtaining better mechanical properties after heat treatment. In connexion with this work, a method has been employed of purifying magnesium by sublimation. Ordinary magnesium is heated *in vacuo* in a crucible to a temperature about 50° C. below its melting point, when it sublimes and is deposited on the cooler parts of the furnace tube, to which it is prevented from adhering by a layer of magnesium oxide. The tubular deposit is afterwards withdrawn. Most of the impurities are left behind in the crucible.

For research on the cracking of boiler plates, an apparatus has been constructed for studying the effects of corroding media, such as caustic soda, on the stability of stressed steel at boiler temperatures and

pressures. Small specimens of boiler plate completely immersed in a corrosive solution can be tested under tension in a seamless high pressure cylinder of steel, which is heated electrically. Steam pressures up to 500 lb. per square inch can be obtained. Apparatus has also been developed for studying the corroding action of superheated steam on materials which are suitable in other respects for use in steam power plant. A special boiler is utilised, consisting essentially of a long coiled tube of rust-resisting steel, which is heated electrically and through which water is circulated. The steam generated is superheated electrically in a stainless steel vessel which contains the material under test. Steam pressure of 1000 lb. per square inch at a temperature of 600° C. can be obtained with the apparatus.

Research work is being carried out in the department, under the auspices of the Dental Investigation Committee of the Department of Scientific and Industrial Research, to determine the factors which affect dimensional changes in dental fillings when these are packed into a tooth. The effects of pressure during the operation of filling, of particle size in the amalgam, and of the proportion of the constituents in the amalgam are being investigated. For this work special lever dilatometers have been designed. These are enclosed in a specially constructed thermostat, so that the experiments can be conducted at ordinary mouth temperatures.

In a number of researches in the department, crucibles and tubes impervious to gases are needed. These are unobtainable commercially in Great Britain and their manufacture has been investigated in the department. Specimens of non-porous sheaths of pure alumina glazed by fusion were exhibited, and their use in optical pyrometry, where the presence of gases and vapours would affect the measurements, was demonstrated.

In the Metrology Department a new balance to weigh loads up to one kilogram has been constructed. This balance will be used for work of the highest precision and in particular for the periodic verification of the national standards of mass. Provision has been made for weighing either in air or *in vacuo*, and for accurate adjustment of the knife edges. To obviate magnetic disturbances, no magnetic material has been employed in the construction of the balance. The apparatus will be operated under steady temperature conditions, and provision has been made for reading the balance and for interchanging weights by means of remote controls.

Experimental apparatus for the measurement of very fine wire such as is used in electric lamps has been developed in the department. The instrument is a combination of a mechanical and optical lever, giving an overall magnification of 15,000. The diameter of the wire can be measured to a few millionths of an inch, and very small variations in thickness can be detected.

In the Heat Division of the Physics Department a number of investigations were in progress on behalf of the Food Investigation Board. Apparatus has been constructed for the measurement of the thermal conductivity of heat insulating materials at low temperatures. The equipment, which is fitted with a novel guard ring system, includes a refrigerating plant and automatic control for maintaining the cold plate at any desired temperature. Considerable work has also been carried out in connexion with the heat transfer between air and banks of metal pipes through which a refrigerant is circulated. The laws of heat transfer for various assemblages of pipes and for a succession of lengths of pipes placed longitudinally in an air stream have been investigated.

For measurements of the thermal conductivity of heat insulating materials at high temperatures, apparatus has been constructed in which samples, the surfaces of which are not flat, can be tested. A Silit heater furnace is so arranged that the face of the specimen can be viewed with an optical pyrometer. Of interest also was a calorimeter for the measurement of the heats of combustion of gases. An adiabatic system is adopted in which the calorimeter is heated electrically at a controlled rate. The apparatus is capable of giving results to a high order of accuracy.

In the Radiology Division considerable work has been done in connexion with the realisation of the X-ray unit of quantity, the Röntgen. In this work precise control of the X-ray output is required, and a constant potential generator has been constructed which enables voltages of 40-230 kilovolts to be applied with a voltage variation not exceeding 1 per cent. A new primary ionisation chamber has also been designed. It is of interest to note that in an intercomparison of the new unit by the three national laboratories of America, Germany, and Great Britain, agreement was obtained within 0·5 per cent.

As an example of the way in which X-rays can be applied to industrial problems, mention may be made of the X-ray examination of chromium plating, which can vary from a bright hard deposit to a grey matt one, depending on the conditions in the plating bath. It is found that the differences in the deposit are due to variations in the shape and size of individual crystals. The brilliant surface is almost invariably associated with the smallest grain size.

In the Optics Division, charts were shown illustrating the new system of colorimetric standardisation adopted by the International Commission on Illumination in 1931. The trichromatic system of colorimetry developed at the Laboratory, in which three spectrum colours are employed as primaries, is utilised. A standardised illuminant is used consisting of a tungsten gas-filled lamp and a special colour filter. The standard colorimetric apparatus used at the laboratory was exhibited.

In the Sound Division the considerable demand for acoustical tests of absorbent materials used in the correction of defective auditoriums is reflected in various improvements in apparatus employed for the work. The measurement of sound intensity in absolute units has received considerable attention, particularly with the view of the absolute calibration of high quality electrical microphones, such as are required for modern developments in gramophone recording and in broadcasting.

In connexion with the rapid visual observation or photographic recording of the variation with frequency of the sound intensity of the note emitted by a loud-speaker, a novel use is made of a cathode ray tube. By means of a special circuit, the intensity of sound from the loud-speaker is plotted visually against a frequency scale instead of the time scale which is usual in oscillographic work.

In the Electric Standards Division of the Electricity Department was shown a piezo-electric quartz oscillator in the form of a ring, to serve as a primary standard of radio frequency. Experiments have shown that the modulus of elasticity of a quartz ring cut with its plane perpendicular to the optic axis is practically constant for all directions in this plane. This form of oscillator is thus eminently suitable for use as a standard of frequency. The oscillator is supported in a vacuum chamber and is thermostatically controlled.

In connexion with measurements of permeability, demonstrations were given of the changes which may occur with time in some materials when a small alternating magnetisation is superimposed on a large d.c. magnetisation. It has been found that in such cases the value of the permeability decreases continuously

for some time after the current is switched on. The amount of change varies with the material and the amplitude of the alternating magnetisation.

In the Electrotechnics Division, apparatus was shown for analysing the motion of rapidly moving automatic switchgear. An oscillographic method is employed, and from the records it is possible to determine the velocity of the moving parts while the switch is being broken, and also the time taken to complete the breaking of the circuit.

In the Wireless Division the fundamental work on very short waves has been continued. For comparison with theory, an apparatus has been developed for the study of the propagation, along the earth's surface, of ultra-short waves of wave-length 1·6 metres. Measurements are made of the decrease of signal strength with distance, at a height up to about 5 metres. A small, single valve, retroaction type oscillator is used as the transmitter, and no aerial is employed. The intensity measurements are made from a distance, with the aid of a telescope, to avoid disturbances in the field due to the proximity of the observer.

Another interesting exhibit showed the production and measurement of oscillations of wave-lengths between 14 and 80 centimetres. These waves are produced by the oscillation of electrons about the grid, which occurs in some valves when the grid has a high positive and the anode a slightly negative potential with respect to the filament.

In connexion with the investigation of the effects of glare undertaken by the Photometry Division, a new form of photometric pupilometer has been devised. In this instrument the observer views an ordinary photometric field, both halves of which are illuminated by the Maxwellian method, in which the light source is focused at the observer's eye. The illuminant for one half of the field is a bright spot, the image of which is considerably less than the smallest diameter of the pupil of the eye. The other half of the field is illuminated by an extended surface, so that the amount of light received varies with the aperture of the pupil. By making a photometric balance it is possible to determine the size of the pupil.

In the High Voltage Division, two high voltage sources of direct current have been constructed, incorporating in one case full-wave and in the other half-wave rectification. The former, which is capable of giving 200 kilovolts, will be used for providing the accelerating voltage for an impulse generator and for general research. The latter, designed for 100 kilovolts, is primarily for use with a high voltage cathode ray oscillograph.

In the William Froude Laboratory, tests were being conducted with a model high speed steamer to determine the effects of rough water on the resistance of ship forms and upon the propeller efficiency, with the view of obtaining improved ship economy at sea. The model was entirely self-propelled through rough water created by the wave machine. Measurements were made of the speed, the power required to drive the model, and the thrust of the propellers. At the same time continuous records were made of the pitching of the hull. Of interest also was a model of an improved design of Thames barge constructed to the designs of the Laboratory. Comparative tests with barges of normal type have shown that with the new design a 33 per cent improvement in speed is obtained, while the power expenditure of the tug is slightly reduced.

International Congress of Prehistoric and Protohistoric Sciences

NOW that the programme is virtually complete, it is safe to predict success for the first International Congress of Prehistoric and Protohistoric Sciences, the first international archæological congress to meet in Great Britain since 1868. When the members assemble in London on Aug. 1, practically every nationality will be represented, and the communications to be submitted will afford a very fair conspectus of the more important departments of prehistoric research as it stands to-day. British archæological studies in various parts of the world, in particular, will be well represented.

Some preliminary information relating to the organisation of the Congress and the excursions of archæological interest which are to follow has already been given in NATURE (see March 26, p. 479) and need not be repeated. In addition to the communications which will be presented to the sections of the Congress at King's College and the presidential address, in which Sir Charles Peers will review the beginnings of archæological studies in Great Britain, discourses will be delivered at general meetings to be held in the evening on Tuesday, Wednesday, and Friday in the Congress week. The speakers will be: Dr. Cyril Fox, director of the National Museum of Wales, on the control of physical geography in the early history of human habitation; and Mr. E. T. Leeds, keeper of the Ashmolean Museum, Oxford, and Mr. T. D. Kendrick, of the British Museum, on the outstanding material expressions of the Celtic and Teutonic civilisations. A fourth general meeting on Saturday morning will be addressed by Mr. O. G. S. Crawford on "Air Photography and Archæology". Here may also be mentioned, as outside the sectional routine, though connected with the proceedings, a visit to the famous palæolithic gravel pit at Swanscombe and an extensive exhibition at Bedford College illustrative of the report which Miss Caton-Thompson will read on her investigation of the prehistory of the Kharga Oasis, Egypt.

Turning to the work of the sections, it is possible to mention here a very small selection only of the large number of papers which have been accepted and allocated to the programmes of the five sections into which the work of the Congress has been classified. In Section I. (Human Palæontology), under the presidency of Sir Arthur Smith Woodward, the most attractive topic undoubtedly will be the recently discovered human remains from Mount Carmel, Palestine. Of neanderthaloid type, but aberrant from that type, they will be described, perhaps exhibited, by Mr. T. McCown, the finder, and discussed by Sir Arthur Keith. The morphology and antiquity of man in America will be the subject of discussion by Dr. Bruno Oetteking, and Dr. L. S. B. Leakey will describe the fossil teeth of Miocene anthropoids recently found by him on the shore of Lake Victoria in East Africa and the circumstances of their discovery.

Mr. Reginald Smith, presiding over Section II., will be concerned with a variety of problems relating to the old stone age, ranging from Africa to the extremes of Europe and Asia. Dr. L. S. B. Leakey will deal with the prehistoric cultural sequences at Oldoway, Tanganyika, and Messrs. Miles Burkitt and E. J. Wayland will discuss the Mgosian culture of Uganda. Prof. R. Vaufrey's paper on the Acheulean of Gafsa, should be valuable. The Abbé Breuil will give the results of his first-hand observation on fire and the bone and stone implements in the cave of Peking man, and he will also review our present knowledge of palæolithic

cave art. A department of the latter topic, the art of the Spanish caves, will be the subject of consideration by M. L. Pericot. Dr. B. S. Petri will describe the palæolithic culture of Siberia.

A number of members will deal with aspects of mesolithic culture: M. Reygasse on the Tardenoisian of North Africa, Prof. Antoniewicz on early man in north-east Poland and Lithuania, Prof. E. Plopson on Rumania, and Prof. R. Serpa da Pinto on Portugal.

Questions relating to the neolithic, bronze, and iron ages in the ancient world fall to the province of Section III., which being by far the largest section, has had to be subdivided. Cis-Alpine European prehistory, under Prof. H. J. Fleure, will devote considerable attention to megalithic monuments, with papers by Prof. Daryll Forde on the varied typology of Breton megaliths, the veteran M. Le Rouzic on the relative chronology of the prehistoric burials of the Morbihan, Prof. R. A. S. Macalister on the horned cairns of Ireland, Mrs. Cunnington on 'Wooden Circles', and Mr. H. St. George Gray on his excavation of Avebury. The interest of this group is rivalled by Prof. Siret on the problem of the æneolithic age and M. Vouga on his investigations in the lake villages of Switzerland. Mr. C. A. R. Radford will describe the hill-villages of the south-west of England, Mr. Hencken will discuss the Cornish tin trade, and Mr. A. Keiller will give an account of the extremely important settlement which he has excavated at Windmill Hill. A question which has long demanded ventilation will be opened by Mr. Brynner Jones on the origin of British domestic cattle and especially the domestic ox.

In the section dealing with the Near East, under the joint presidency of Prof. J. L. Myers and Mr. Sidney Smith, importance will be attached to Sir Arthur Evans's demonstration of the great cleavage between Knossos and Mycenæ in Late Minoan i.b. and the later unifying reaction from Crete. Mesopotamia is represented by, among others, Mr. Leonard Woolley on the early graves of Ur, Mr. Harden on painted pottery from Kish, and Dr. H. Frankfort on Syrian and Anatolian influences in Mesopotamia; while from Anatolia, Dr. H. van den Osten will describe the æneolithic settlement at Alishar in Cappadocia. There may also be mentioned Prof. Gordon Childe on the bearing of a newly discovered metal type from the east on European bronze age chronology, and Dr. O. Menghin on excavations at Beni Salameh in relation to their significance for European prehistory. This must suffice, though it is far from exhausting the list.

The section devoted to areas outside Europe will be much preoccupied with the archæology of beads, especially from Indian iron age burials in the Deccan, described by Mr. E. H. Hunt, and from China, the latter being designated as "of foreign origin". Prof. C. G. Seligman and Mr. Beck jointly will be responsible for the discussion of the latter, and Mr. Beck for the former.

The transition from prehistory to history, the work of Section V. under Mr. E. T. Leeds, deals with the movements of races, Saxons, Vikings, Slavs, etc., in the early centuries of our era. Dr. Schetelig, the foremost of Viking archæologists, will cover broadly the excursions of this people, and Prof. T. Balodis will discuss Lettish origins in this period. Tombs of the Roman iron age in North Jutland will be described by Prof. J. Brønsted, and Dr. A. W. Brøgger will review recent evidence bearing on the iron age in Norway. Mr. E. MacNeil will deal with the Picts, Mr. C. Hawkes with the relations of iron age enclosures in Britain and on the Continent, and last, but by no means least in interest, Mr. E. T. Leeds will review the evidence for the penetration of the Saxons into the upper Thames region.

University and Educational Intelligence

EDINBURGH.—Curricula for the degree of B.Sc. with honours in anthropology have been approved.

Following on the resignation of Dr. C. B. Williams of the lectureship in agricultural and forest entomology, the two lectureships in entomology in the University have been more closely correlated. Dr. A. E. Cameron, at present lecturer in medical entomology, has been placed in general charge of the instruction in entomology in the University, and Mr. J. W. McHardy, formerly entomologist attached to the Medical Department of Tanganyika Territory, has been appointed as the other lecturer in entomology.

Prof. A. J. D. Porteous, McGill University, has been appointed to the lectureship in ancient philosophy about to be vacated by the resignation of Mr. R. P. Hardie.

Intimation has been received of the following resignations: Dr. T. W. M. Cameron, lecturer in helminthology, on appointment as research professor in helminthology at McGill University; Mr. A. D. Hobson, lecturer in zoology, on appointment to the chair of zoology at Armstrong College, Newcastle; Dr. Edward L. Ince, lecturer in mathematics, on appointment to the Imperial College of Science, South Kensington, London.

LONDON.—University post-graduate travelling studentships of the value of £275 for one year have been awarded to Dr. B. W. Bradford (Imperial College of Science and Technology) and Muriel H. E. Long (King's College and King's College Hospital). Dr. Bradford proposes to study the adsorption of gases on metals with particular reference to polar factors, at Frankfort-on-Main, and Miss Long will study surgery and its practice in Vienna, Cologne, Berlin, and Budapest, making Vienna her base, and specialising in stomach surgery.

PROF. A. C. MENZIES, professor of physics at University College, Leicester, has been appointed professor of physics at University College, Southampton.

ECONOMIC depression and unemployment in America have stimulated interest and activity in what is known as the 'educational guidance' movement. An official report on recent developments of the movement is published in *School Life* for May, which also contains an editorial describing how continuation and other schools in various parts of the country are adapting their resources to the task of aiding the unemployed. Among the evidences of increased attention to educational guidance is an increase in the number of schools providing organised guidance services. In Pennsylvania alone 800 now have counsellors or advisers on an extra-curricular, part-time or full-time basis, or have established group guidance through classes in opportunities or occupations. Many State and local communities are organising associations for promoting public-school guidance programmes. Guidance figures more largely in programmes of educational conferences, local, State, and national. The output of literature bearing on the subject is enormous, including textbooks for teachers' training colleges, occupational studies issued by directors of education, reports issued by associations, such as the American Vocational Association, vocational surveys and monographs by research workers. Educational broadcasting programmes also give prominence to vocational guidance, while State departments are including guidance work in State courses of study. In Idaho, the State Board of Education has arranged for the formulation of a State guidance programme.

Calendar of Geographical Exploration

July 18, 1801.—Matthew Flinders' Journeys

Matthew Flinders sailed from Spithead in the *Investigator*, commissioned to explore the coasts of Australia, especially the little-known south coast. He discovered Spencer Gulf, St. Vincent Gulf, and Kangaroo Island, and, in a later voyage, circumnavigated Australia. His scientific work was of a high order and added much to our knowledge of magnetism, meteorology, and hydrography. He is said to have been the first to discover, and make corrections for, the effect of iron in the ship on the magnetic compass. In 1798, Flinders and Bass had sailed through the strait between Australia and Tasmania. Flinders achieved success in spite of many difficulties, which included leaking vessels, scurvy, and on one occasion the wreck of his vessel on a coral reef. Undaunted, he set off in a rowing boat to secure help, while the officers and men camped on a sandbank.

July 19, 1619.—Dutch Exploration of the West Coast of Australia

Two ships of the fleet commanded by Frederik Houtman touched the west coast of Australia in 32° 20′ S. Steering northwards to 27°, the commanders came to the conclusion that the coast formed part of the mainland off which Dirk Hartogszoon had, in October 1616, discovered Dirk Hartog Island. The knowledge of the west coast of Australia gained by several Dutch voyages at this period, including that of the *Leeuwin* in 1622, from which the southern cape was named, resulted from an order of the directors of the Dutch East India Company. They instructed captains sailing east from the Cape of Good Hope to take a more southerly course, in the hope of finding a better route to Java; thus within thirteen years, 1616–1629, the west coast of Australia between Cape Leeuwin and 21° S. was charted.

July 19, 1738.—Bouvet Island

Lozier Bouvet sailed from Lorient with two ships fitted out by the French East India Company. Stories of a pleasant land lying south of the Cape of Good Hope, led to the dream of establishing upon it a port of call for French vessels trading to India and China. The stories date back to the early sixteenth century, when a Norman noble, the Sieur de Gonneville, on a voyage to India, was driven ashore on a land still unidentified, but possibly southern Brazil. On Jan. 1, 1739, Bouvet sighted land, now known as Bouvet Island. Bouvet's voyage disposed of the more fantastic theories about Gonneville Land: he sailed for 48° of longitude roughly in 55° S. He described for the first time the huge flat-topped antarctic icebergs.

July 20, 1793.—Alexander Mackenzie in North America

Alexander Mackenzie reached the Pacific at the mouth of the Bellacoola River. He left England in 1792, proceeded to Chipewyan, and later wintered on the Peace River. On June 12 he reached the sources of the Parsnip, and by a short portage arrived at the Fraser system. He then crossed to the Bellacoola and followed it to its mouth, thus showing the practicability of intercourse between the Atlantic and Pacific Oceans. In 1789 he sailed down the Slave River to the Great Slave Lake and followed it to its delta, where, from Whale Island, he saw the Arctic Ocean. This journey was a remarkable feat, 2990 miles of difficult country having been covered in 102 days. These two achievements place Mackenzie in the front ranks of exploration.

Societies and Academies

LONDON

Geological Society, May 25.—Baron Ferencz von Nopcsa: The influence of geological and climatological factors on the distribution of non-marine fossil reptiles and Stegocephalia. A study of the terrestrial tetrapods and their distribution indicates three lines of migration in Upper Palæozoic and Lower Mesozoic times: (1) North America to Europe, thence through India and the Malay Archipelago to Australia, and from there to South America; (2) Central Asia to South Africa; and (3) Africa to South America. In Jurassic, Cretaceous, and Tertiary times there appear four lines: (1) Europe to Asia, the Malay Archipelago, and South America; (2) Asia, Fenno-Scandia, Greenland, and North America; (3) Central Asia to South Africa; and (4) North Africa to Brazil. To some extent these migratory lines are the same as those of Upper Palæozoic and Lower Mesozoic times. An attempt is made to correlate them with large-scale tectonic movements of folding and marine transgression, together with continuous changes in the ecliptic, bringing about a cycle of climatic and seasonal changes.—**K. A. Davies**: The geology of the country between Abergwesyn (Breconshire) and Llansawel (Carmarthenshire). The country described lies on the north-western side of the Towy anticlinorium. The rocks belong wholly to the graptolitic facies, and are very similar to those in adjacent areas which have already been described. It is suggested that the differences in grain are indicative of the varying depth of the sea-floor when deposition took place, the coarse deposits being laid down in banks tailing off from the areas made shallow by the cross-folding movements.—**K. A. Davies and J. I. Platt**: The conglomerates and grits of the Bala and Valentian rocks of the district between Rhayader (Radnorshire) and Llansawel (Carmarthenshire). A description is given of the distribution and field characteristics of the arenaceous bands, as well as a petrographical description of the included pebbles of the conglomerates and of the heavy mineral constituents of the grits. Most of the pebbles are quartzite and vein-quartz; sandstones, shales, etc., also occur frequently, but numerous pebbles of igneous rocks were found, as well as a few metamorphic types. The majority of the igneous pebbles are acid volcanic rocks, but interesting intrusive types also occur. All the igneous rocks are rich in soda.

Royal Meteorological Society, June 15.—G. I. Taylor: The resonance theory of semidiurnal atmospheric oscillations. The theory that the semidiurnal oscillations in the atmosphere are due chiefly to resonance requires that a free period very close to 12 hours shall exist. Theory shows that the corresponding speed of a tidal free wave is 910 ft. per sec., but direct calculation, and also observations of the Krakatoa air wave, agree in giving the velocity of free gravity waves as about 1050 ft. per sec. It has been suggested that this discrepancy might be explained if rapid pressure changes take place adiabatically while semidiurnal changes are more nearly isothermal. This theory is untenable, because the radiation or conduction necessary to produce any appreciable difference in the speed of the wave from that appropriate to adiabatic changes would give rise to so much damping that amplification by resonance to the desired extent would be impossible, even if the free period of the atmosphere were exactly 12 hours.—**H. L. Wright**: The variation of soil temperature below turf: a discussion of observations at Kew Observatory. Heat passes from 10 cm. to 20 cm. more rapidly

by about one hour and a half than is consistent with the decrease in the ranges of temperature at these depths. The suggestion is advanced that the grass interferes with the normal course of heat conduction. —**J. M. Sil**: Variations in potential gradient caused by some meteorological phenomena. The author has brought together a number of examples of abnormalities in potential gradient and has endeavoured to trace the connexion between them and some meteorological phenomena such as strong insolation, strong wind, the occurrence of a sea breeze, dust storm, etc. The abnormal effect caused by a dust storm was also produced experimentally on a calm day by blowing a small quantity of local dust particles at a point 3 ft. below the collector, when the earth's positive field was quickly reversed.

PARIS

Academy of Sciences (vol. 194, pp. 1869–1992, May 30).—The president announced the death of Roland Thaxter, *correspondant* for the Section of Botany, and of Albert Durand de Grossouvre, *correspondant* for the Section of Mineralogy.—**Ch. Lallemand**: Some geographical discoveries made recently in the antarctic region. Results obtained by the whaler *Norvegia*, a vessel specially equipped for survey work.—**L. Blaringhem**: Intersexual individuals in *Aquilegia*.—**P. Viala** and **P. Marsais**: A parasite of vine mildew. *Trichothecium plasmoparæ* has been found to be a parasite of the mildew fungus of the vine. The possibility of utilising it to fight the mildew is discussed.—**Charles Achard, Augustin Boutaric,** and **Maurice Doladilhe**: The influence of heating serum on the flocculation caused by dilution with distilled water. After heating to temperatures between 48° and 60° C., dilution with distilled water gives no separation of globulins.—**Maurice Gignoux**: The possibility of the existence of the Neocomian in the Embrunais zone on the right bank of the Durance.—**Georges Bouligand**: Level ensembles of a function of the distances of a point with several ensembles.—**S. Mandelbrojt**: The Dirichlet series the exponents of which are linearly independent. —**Vladimir Bernstein**: A generalisation of the exponential summation method of Borel.—**Mlle. Mary L. Cartwright**: The Borel directions of integral functions of finite order.—**J. Leray**: The movements of unlimited liquids.—**Max Serruys**: The calculation of an upper limit of the duration of detonation in internal combustion motors and the explanation of the presence of a gap in the diagrams given by certain electric manographs.—**Georges Mabboux**: The photo-elasticimeter extended to the study of reinforced concrete. An application of optical methods capable of showing changes in structures which have been built some time.—**J. Dufay**: Emission bands and lines in the spectrum of the night sky.—**R. Wavre** and **P. Dive**: An example of a multiform harmonic function furnished by the theory of Newtonian potential.—**Jean Jaffray** and **Pierre Vernotte**: The existence of high frequency oscillations in the secondary current of high tension magnetos.—**Michel Durepaire**: A method of comparison of small capacities.—**G. A. Beauvais**: A radiometer sensible to Hertzian waves.—**Antonio Rostagni**: The properties of gases ionised with high frequency currents.—**Jean Louis Destouches**: The theory of the diffusion of neutrons, absorption coefficient, and ionisation.—**M. E. Nahmias**: Anomalous absorption by lead of X-rays at about 210 kv. This anomalous absorption, of which no explanation is obvious, agrees with earlier figures given by Jaeger. —**I. I. Agarbiceanu**: The fluorescence spectrum of I_2.—**D. Skobelzyn**: The Compton effect of the very hard γ-rays of ThC''.—**M. Haïssinsky**: The electrolytic deposit of polonium on various metals.—**S. Rosenblum** and **G. Dupouy**: Absolute measurements of the velocities of the principal groups of α-rays. Work done using the large electromagnet of the Academy of Sciences. The velocity of the α-rays of RaC′ ($1{\cdot}922 \times 10^9$ cm./sec.), used as a base number, agrees with the figure given by Rutherford and Robinson.—**Jean Jacques Trillat**: The changes of structure of nitrocellulose films in the course of drying.—**Ch. Zinzadzé**: The buffer power of some slightly soluble phosphates. A diagram is given showing the buffer action of magnesium and calcium phosphates.—**H. Muraour** and **G. Aunis**: The influence of the temperature of the (explosive) powder on the variation of $\int p.dt$ at different densities of charge.—**Victor Lombard** and **Charles Eichner**: The diffusion of hydrogen through palladium. Curves are given showing the amounts of hydrogen diffused through palladium at constant pressure with temperatures varying between 196° and 600° C., and at constant temperature (372° C.) with varying pressures.—**Mlle. Suzanne Veil**: The precipitation of methylene blue by various electrolytes in gelatine.—**Maurice Doladilhe**: The influence exerted by an electrolyte on the fixation of colloidal colouring matters by the granules of a hydrosol.—**M. Auméras** and **A. Tamisier**: The decomposition with increasing temperature of the ammine and hydrated metallic complex compounds.—**T. Karantassis** and **L. Capatos**: The use of potassium stannichloride ($K_2SnCl_4 . 2H_2O$) in analysis. This salt is stable and non-hygroscopic and can be used in volumetric analysis.—**A. Sanfourche** and **Jean Henry**: The action of water on dicalcium phosphate.—**P. Cristol** and **J. Cayla**: A new conjugated molybdenum blue, boro-molybdic blue. —**Albert Kirrmann**: The condensation of pyruvic acid with aldehydes.—**Lespieau** and **Wiemann**: The synthesis of racemic mannite. Acrolein is oxidised with silver chlorate in the presence of osmic acid: one of the products is shown to be mannite.—**Mailhe, Marty,** and **Gaudry**: The decomposition of hydroaromatic hydrocarbons. A study of the decomposition of cyclohexane at temperatures between 500° and 750° C. in presence of silica gel as catalyst.—**Ch. Courtot** and **H. Hartman**: The chromatability of the azo colouring matters produced from the hydroxyquinolines.—**Georges Lévy**: The preparation of a new ethylnaphthol.—**V. Cerchez** and **Mlle. C. Colesiu**: The reduction of the acetyloximino esters.—**J. Orcel**: The existence of coronadite in the manganese minerals of Bou Tazoult, Imini region, Morocco.—**Raymond Furon**: The phosphate rocks of the Gabon coast.—**E. Chaput**: Geological observations in Asia Minor: the upper Cretaceous in Central Anatolia.—**Elie Gagnebin**: The presence of the Gault in the breccia of Chablais (Haute-Savoie).—**Louis Dubertret**: The structural evolution of the Levant States under the French mandate.—**Nicolas Menchikoff**: The Devonian containing cephalopods of Oued Saoura and the chains of Ougarta (Sahara).—**Maurice Blumenthal**: The stratigraphic material of the Bokoya stratum.—**Maurice Suess**: The presence of gastropods and of vertebrates in the Bou Hanifia grit, Hascara sheet (Oran).—**G. Depape**: The Tertiary plants of Wei-tchang (China).—**Paul Becquerel**: The anhydrobiosis of the tubers of *Ranunculus* in liquid nitrogen.—**Pierre Chouard** and **Georges Teissier**: Variations in the intensity of growth in melon seedlings in the course of development as a function of the amount of available reserves.—**J. Chaine** and **J. Duvergier**: The differentiation of fishes of the genus *Ophidium* by their otoliths.—**Mlle. M. Friant**: The abrasion of the molars *in utero* of rodents of the Caviideæ.—**Raymond-Hamet**: The natural classification of the amines similar to adrenaline. The suggested classification is based on the vascular action of maximum doses of the amines.—**Fernand Mercier**: The influence of the intrarachidian injection of cocaine or its substitutes on the cardio-vascular action of

adrenaline.—**R. Monceaux** and **H. Godard**: The presence of tyrosine and of other free amino-acids in a nævocarcinoma without pigment.—**Maurice Piettre**: Casein complexes. Calcium caseino-phosphate in milk. Reply to a criticism by Porcher and Brigando. —**Jean Caminopetros**: The sensibility of the spermophil *Citillus citillus* to icterohæmorragic spirochetosis.

CAPE TOWN

Royal Society of South Africa, May 18.—**H. G. Fourcade**: Contributions to the flora of the Knysna and neighbouring divisions. In preparing a list of the flowering plants found in the divisions of George, Knysna, Humansdorp, and Uniondale, based chiefly on his own collections at intervals during many years, the author wished to include the new species collected by himself that were still undescribed, and with this object has supplied their description in the paper. He has added the name changes in his list that have been rendered necessary by the international rules of botanical nomenclature. In testing the numerous new combinations that have already been made by others since the publication of the "Flora Capensis", a number of illegitimate changes were found, and these are rectified whenever they relate to species included in the compiled list.

Forthcoming Events

WEDNESDAY, JULY 20

BRITISH MEDICAL ASSOCIATION (Fourth Victor Horsley Memorial Lecture at University College Hospital Medical School, Gower Street, W.C.1.).—Prof. E. D. Adrian: "The Visceral Sense Organs," at 5 P.M.

Conferences

JULY 23–30

BRITISH MEDICAL ASSOCIATION (London) Centenary Meeting.

Official Publications Received

BRITISH

The Norman Lockyer Observatory Director's Annual Report, April 1, 1931–March 31, 1932. Pp. 8. Council's Report and Accounts, and List of Council, Staff, Members, etc., June. Pp. 9. (Sidmouth.)

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 18, No. 1, May. Pp. 433. (Plymouth.) 17s. 6d. net.

Proceedings of the Society for Psychical Research. Part 125, Vol. 40, June. Pp. 389-441. (London: Society for Psychical Research.) 4s.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 71, No. 426, June. Pp. 144+xviii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

The Relation of Food to Disease. By Stanley Dixon. Pp. 38. (London: Institute of Chemistry.)

Proceedings of the Royal Physical Society, Session 1931-32. Vol. 22, Part 2. Pp. 75-106. (Edinburgh: Oliver and Boyd.)

City of Stoke-on-Trent. Report on the Corporation Museums and Art Gallery for the Two Years to 31st March 1932. Pp. 14+2 plates. (Stoke-on-Trent.)

Experimental and Research Station, Nursery and Market Gardens Industries' Development Society, Ltd., Turner's Hill, Cheshunt, Herts. Seventeenth Annual Report, 1931. Pp. 71. (Cheshunt.)

New Zealand: Marine Department. Fisheries Bulletin No. 5: On the Depreciation of Trout-Fishing in the Oreti (or New River), Southland, with Remarks on Conditions in other Parts of New Zealand. By Prof. E. Percival. Pp. 48. (Wellington, N.Z.: Government Printing Office.) 1s. 9d.

The Indian Forest Records. Silviculture Series, Vol. 17, Part 2: Treatment of Babul (*Acacia arabica*) in Berar. By S. A. Vahid. Pp. v+42+10 plates. (Calcutta: Government of India Central Publication Branch.) 1.14 rupees; 2s. 3d.

Memoirs of the Asiatic Society of Bengal. Vol. 11, No. 4: String Figures from Gujarat and Kathiawar. By James Hornell. Pp. ii+147-164. (Calcutta.) 1.2 rupees.

Canada: Department of Mines: Geological Survey. Summary Report 1931, Part A. (No. 2305.) Pp. 120. Summary Report 1931, Part D. (No. 2306.) Pp. 58. Economic Geology Series, No. 9: Oil and Gas in Eastern Canada. By G. S. Hume. (No. 2294.) Pp. vii+187. 30 cents. (Ottawa: F. A. Acland.)

Canada: Department of Mines: National Museum of Canada. Bulletin No. 68: Annual Report for 1930. Pp. 91. (Ottawa: F. A. Acland.)

The Welsh Journal of Agriculture: the Journal of the Welsh Agricultural Education Conference. Vol. 8. Pp. 272. (Cardiff: University of Wales Press Board.) 2s. 6d.

Results of Meteorological Observations made at the Radcliffe Observatory, Oxford, in the Five Years 1926–1930, under the direction of Dr. H. Knox-Shaw. (Published by order of the Radcliffe Trustees.) Vol. 56, with Appendix. Pp. viii+118. (London: Oxford University Press.)

The Observations of the Reverend Thomas Hornsby, D.D., Savilian Professor of Astronomy and Radcliffe Observer, made with the Transit Instrument and Quadrant at the Radcliffe Observatory, Oxford, in the Years 1774 to 1798. Reduced by Dr. H. Knox-Shaw, Dr. J. Jackson and W. H. Robinson. (Published by order of the Radcliffe Trustees.) Pp. 145. (London: Oxford University Press.)

FOREIGN

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University (Publications de la Faculté des Sciences de l'Université Masaryk). Čís. 146: Sur les hypercirconférences et certaines surfaces paraboliques dans l'espace euclidien à quatre dimensions. Par Otakar Borůvka. Pp. 40. Čís. 147: K teorii Markovovych řetězů (Sur la théorie des chaînes de Markoff). Napsal Miroslav Konečný. Pp. 18. Čís. 148: Generis Trigonella L. revisio critica, V. Scripsit G. Širjaev. Pp. 43. Čís. 149: Předmiocenní relief a miocenní plošiny v oblasti střední Svratky (Le relief prémiocène et les plates-formes miocènes dans la région de la Svratka moyenne). Napsal Fr. Říkovský. Pp. 21. Čís. 150: Anthropologie Podkarpatské Rusi s některými poznámkami o lidských plemenech vůbec a o metodách anthropologických; Předběžná zpráva (Anthropological Notes on the Peoples of Carpathian Ruthenia, with remarks on Races in General and on some New Methods in Anthropology; Preliminary Report). Napsal Prof. V. Suk. Pp. 29. Čís. 151: Afinita chemických reakcí (Affinity of Chemical Reactions). Napsal Bedřich Macků. Pp. 15. Čís. 152: Fluviatilní terasy střední Svratky (Les terrasses de la Svratka moyenne). Napsal Fr. Říkovský. Pp. 23. (Brno: A. Píša.)

Biologické Spisy vysoké Školy Zvěrolékařské (Publications biologiques de l'École des Hautes études vétérinaires), Brno. Svazek 10, Spis 141-150. Pp. iii+25+10+10+13+29+20+40+45+14+25. (Brno: A. Píša.) 50 Kč.

Sborník vysoké Školy Zemědělské (Bulletin de l'Institut National Agronomique), Brno. C. 19: Příspěvek ke studiu vzrůstových činitelů kapřího plůdku se zvl. zřetelem na vliv velikosti t. zv. životního prostoru. Napsal Dr. Vasilij P. Černajev. Pp. 75. 18.65 Kč. C. 20: Příspěvek k otázce o vlivu prostoru na vzrůst zvířat (Contribution to the Question of the Influence of the Living-Space on the Growth of Animals). Napsal Dr. Jan Podhradský. Pp. 56. 12.80 Kč. C. 21: Vliv potažních prací na užitkovost dojnic, napsal Dr. Stanislav Koláček; Vliv potažních prací na chemické složení kravského mléka, napsal Dr. Andrej Karakoz. Pp. 78. 15 Kč. C. 22: Veřejný agronom a jeho činnost. Napsal Dr. Vladimír Stein. Pp. 84. 9.80 Kč. C. 23: Příspěvek k poznání Araneid střední Slavonie (Sur quelques Araignées de Slavonie centrale avec la description d'une nouvelle *Salticide fissidentatée* (*Roeweriella balcanica* n. g. n. sp.) et de la nouvelle espèce *Troglohyphantes diurnus* n. sp.). Napsal Josef Kratochvíl. Pp. 16. 2.50 Kč. C. 24: Hydrobiologická studia rybníků lednických. 2: Nástin poměrů algologických na Lednicku. Podává Jindřich Zapletálek. Pp. 70. (Brno: A. Píša.)

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Degussa Products for Stringent Chemical and Thermal Requirements. Pp. 12. (London: Bush, Beach and Gent, Ltd.)

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Modern X-Ray Engineering. Section 2: Screening Stands, Tube Stands, Couches. Pp. 24. (London: X-Rays, Ltd.)

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Science and Social Economics

THOUGH it is recognised that science touches the life of society closely at many points, there are other spheres in which the contribution of science is only just beginning to be perceived. The full effect of the changes in the structure of society, whether in Great Britain or elsewhere, produced by the impact of applied physical science in such ways as the increased facilities for transport over great distances; rapid long-range communication by telephone, wireless, aeroplane; the cinema and broadcasting; and the spread of mechanical production on a large scale in such parts of the world as India, China, and Russia has yet to be perceived. The extent of the influence of these forces or the magnitude of the changes they have produced will undoubtedly be vast but are largely unpredictable. Least of all can they be ignored in a country like Great Britain.

It is largely because of this that authorities like Prof. W. McDougall have attributed much of the responsibility for our present position to our neglect of the social sciences, and have pleaded for the direction of our most powerful intellects from research in the physical sciences into research on the biological, the human and the social sciences. In this manner it would become possible to build the social sciences and especially the science of economics on the basis provided by anthropological research.

There is thus visualised a further wide field in which science can make a contribution of vital importance to the development or even the existence of society. As a balance to the violent changes produced directly or indirectly in our social or industrial life by physical science, there would be accumulated an adequate volume of scientific knowledge of human nature and the life of society which would facilitate the adjustment of our social, economic, and political life in a rational way and apart from sectional prejudices. The development in this way of economics, politics, jurisprudence, criminology, etc., on a basis of facts and a sound or scientific psychology, would afford sure guidance in dealing with the many difficult problems which confront us in national administration, finance, unemployment, trade cycles and international relations to-day.

We have already attempted in administration of the backward races the experimental application of biology or psychology to problems of national and international conduct, and the success achieved indicates the value which such

methods, when widely applied and based on a firm foundation of adequate research, can have in dealing with the racial relations and the evolution of co-operation in place of competition. The confusion which exists in economics to-day is not due to the absence of statistical facts but to our lack of scientific knowledge of imponderable psychological factors having their basis in human energies, in the personal and group loyalties of men, their fears, their ideals, passions, and ambitions. Only by patient research leading to the gradual development of exact knowledge can the world hope to win a more perfect control over the economic organisation resulting from the mechanical mass production made possible by the rapid progress of physical science in the last century.

The contrast between the comparative freedom with which scientific knowledge and development have influenced industrial development and their almost negligible influence in the control of national and international policies which so largely determine the development or stagnation of industry and society as indicated above is startling, and the danger grows. It must not be imagined, however, that science or scientific research offers a ready-made solution of all our present difficulties, or indeed that it is more than one factor in the solution of our national social and industrial problems. It is claimed, however, that in the modern State the problems of national life to an increasing extent involve scientific factors, and cannot be handled aright without scientific knowledge. There can be no adequate control unless the full facts of the situation are taken into consideration and accurately appraised by those competent to assess the scientific aspects along with other factors.

As has often been stated in these columns we need an increasing number of administrators who count among their qualifications a first-hand experience of scientific technique, and a scientific outlook is as essential in national affairs as in industry, if the resources and contribution of science are to be utilised to full advantage. Recent experience indicates that this is likely to be an essential condition of progress. The comparative impotency of Parliament in the present industrial situation is largely due to its lack of inherent scientific and technical knowledge, as well as to the absence of such knowledge in those holding high administrative appointments in the civil service. No severer handicap has been imposed on Great Britain in the present crisis than the exclusion, often deliberate, of technical and scientific men of administrative ability from responsible administrative posts in industry or in Government service. Not until this defect is remedied in Parliament, as in Government service and industries generally, can we expect to see not merely effective and scientific reorganisation of our industries from the point of view of the nation as a whole, but also the initiation of the task of wise international co-operation in a spirit of unselfishness and world service.

The possibilities of the application of scientific method in national and political affairs are indicated by the success of those pieces of reconstruction work in post-War Europe which were based on an impartial scientific analysis of the problem by relevant experts and linked up with the appropriate action. The Austrian and Hungarian reconstruction schemes and the Greek Settlement scheme are examples of a new technique in international affairs, and demonstrate convincingly the function of the technical expert in linking up knowledge and power. The Dawes and Young Commissions are similar examples of this new method of applying the forces of science and expert skill and wisdom to problems declared insoluble by governments and hopelessly vitiated by human prejudice. That their solution was only temporary, and that the problem threatens to be sucked once more into the maelstrom of politics, merely indicates the imperative need for extending this same technique to national and international problems of disarmament, tariffs, reparations, and War debts, etc., which react on the issues involved.

The application of scientific method to the unemployment problem and other industrial or economic difficulties has been further suggested not only in the Macmillan report, which, apart from its assertion that the task of capital development should be attempted in a much more systematic and far-sighted manner than hitherto, visualised a comprehensive rebuilding and replanning policy for our larger towns and industrial centres, the replanning and refitting of staple industries, and the electrification of railway systems, but also by the International Labour Office in its proposals for practical action on unemployment in Europe, which were recently submitted to the Commission of Inquiry for European Union. Without elaborating a definite scheme, the memorandum outlines such ideas as a definitely planned international road system to meet the present-day requirements of rapidly increasing motor traffic, and to provide connexions between the special roads for motor traffic which are at present being constructed everywhere independently in the most advanced countries of Europe; the co-ordination of regional

systems of navigable waterways; the international distribution of electric power, and the concerted and uniform substitution on all European continental railways of a suitable system of automatic coupling in place of the present screw couplings, which are annually responsible for many fatal accidents.

Schemes of this type planned in advance as a definite programme would enable public works to be postponed from a boom period and carried out in a time of depression. They should thus be of direct value in reducing the incidence of unemployment as well as in encouraging the spirit of European co-operation on which the Macmillan report laid such stress.

There is indeed much evidence of a widespread recognition that an era of conscious and deliberate management must succeed the present era of undirected natural evolution. Scientific workers themselves have urged support of leaders who would attempt to plan the reconstruction of the world on the basis of a definite five-year or similar plan.

General Smuts's plea that the scientific expert and his report giving a just and impartial lead to governments should be regularly accepted just as judicial decisions are accepted, as a matter of course, is perhaps less visionary than when it was uttered, and the value of the mature, sober, impartial spirit of science in the functioning of our national and international system may be the nearer recognition because of the present chaos. Sections of the community are disposed to accept the leadership of science, and to adopt a well thought out and comprehensive scheme of national and international reconstruction based upon an authoritative and scientific analysis of the whole situation.

The participation of the scientific worker in this task of reconstruction on equal terms with representatives drawn from other sections of the community should at least enable us to relate administrative action to the full facts of the situation, shatter the influence of prejudice or sectional interests in determining national policy, and bring to an end those gigantic forms of national and communal waste which largely are the result of ignorance on the part of our administrators. Above all, it would ensure that human values and human factors, the neglect of which is responsible for so many of our present difficulties, receive full and sympathetic appraisement because as a result of scientific study they are at last adequately understood.

Bibliographia Zoologica

An Introduction to the Literature of Vertebrate Zoology: based chiefly on the Titles in the Blacker Library of Zoology, the Emma Shearer Wood Library of Ornithology, the Bibliotheca Osleriana, and other Libraries of McGill University, Montreal. Compiled and edited by Dr. Casey A. Wood. Pp. xix + 643. (London: Oxford University Press, 1931.) 63*s*.

THE publication of this imposing volume suggests a consideration of the more important resources already available. For the older literature, that is, up to 1776, we must still rely on Haller's "Bibliotheca Anatomica", which would be an enduring monument to the memory of that remarkable man even if it did not represent but a fraction of his stupendous labours. For the later work there is so far nothing to beat Carus and Engelmann and its continuation by Taschenberg, although the utility of the latter part is sadly discounted, if not destroyed, by the lack of the indexes, which latter, we are informed, are not to be printed—a lamentable decision on the part of the famous German publishing house responsible for the work.

Of works on private libraries, Dryander's catalogue of Sir Joseph Banks's collection is by far the most useful, and is worth its weight in gold. The most distinguished example of the catalogues of public institutions is that of the Natural History Museum at South Kensington—a library not rich in the older literature but containing almost everything else. This catalogue is a masterpiece of bibliographical research, as we had a right to expect from two such adepts as Bernard Woodward and Davies Sherborn. The format of the work under review has been based on the South Kensington example, and no better model could have been selected. The Royal Society's catalogue arouses very mixed feelings. Whilst it would have been easy to have improved this work without materially increasing the cost of compilation, it is, nevertheless, indispensable to every student of the literature of science. The first three series can be obtained in the second-hand market at quite a reasonable cost, but the last series of seven volumes, bringing the work down to 1900, is published at more than £41—a price which rules out the private purchaser and, for that matter, most institutions. On what principles of business and equity this can be justified it is difficult to see.

A work which catalogues any single private or

public library, unless that library be an exceptionally large one, has always one defect and one merit. Its defect is that it is necessarily incomplete, but its merit is that, so far as it goes, it is reliable, since every entry has been written with the work to which it relates in front of the recorder. A compilation, on the other hand, is bound to repeat the errors and misprints of previous compilations. For example, it is generally found that the mistakes in Agassiz' "Bibliographia Zoologiæ" are directly inherited from Boehmer. We must therefore be careful to distinguish between an original bibliography and a second-hand compilation, since it is sound procedure to neglect the latter wherever possible. Dr. Casey Wood's catalogue, however, is a worthy example of the former class of work, and convinces us that the library of the premier University of Canada, at all events so far as zoology is concerned, must be a remarkably fine one. It must not be forgotten, also, that it was to McGill University that the late Sir William Osler bequeathed his own magnificent collection of early medical and anatomical works, some of which figure in the present catalogue.

Dr. Wood has divided his work into three sections. The first (146 pages) is a review of the literature of vertebrate zoology as represented in the McGill libraries up to the year 1930. The second (26 pages) comprises three indexes, which enable the reader to trace works published at specific dates, and those relating to particular geographical regions and to the larger zoological groups. The third section (469 pages) is the alphabetical list of titles. Sections 1 and 2 serve as a very useful introduction, and convert what would otherwise be a mere list into a serviceable guide. Here we find chapters dealing with the beginnings of zoological literature and with the medieval and modern periods. These chapters are brief but informative, and are to be regarded as skeleton outlines for the benefit of the inexperienced rather than as original contributions to the history of zoology. The whole work is a valuable addition to the bibliographical resources of the working zoologist, and Dr. Casey Wood has earned our thanks for reducing so useful a catalogue to the accessibility of print.

Unhappily, with the single notable exception of Edinburgh, universities cannot afford the luxury of printing their library catalogues, but no one can doubt that, were they able to do so, the gain to learning would be considerable. Of the great national libraries of France, England, and Germany, the publication of the French catalogue alone is rapidly approaching completion, but the printing of the English and German catalogues has only just begun, and at the present rate can scarcely be completed within fifty years.

In glancing at Dr. Wood's volume we noticed a number of slips, amongst which were the following: P. 23—Rommel's De Fœtibus (1680) is nothing more than a crude description of a case of abdominal pregnancy and has no embryological interest. P. 42—Haller's connexion with the "Historia Ranarum" (1758) is purely nominal. This beautiful and important book was entirely the work of Roesel. The entry under Haller on p. 375 should be deleted, and that under Roesel on p. 541 retained. P. 43—Bonnet was not the discoverer of parthenogenesis in Aphidæ, but Leeuwenhoeck in 1695. P. 104—Boussuet's "De Natura Aquatilium" (1558) is a metrical version of Rondelet and not a supplement to it. On p. 541 the French translation of Rondelet is wrongly stated to be "probably of Boussuet's edition". It has no relation to Boussuet whatever. Also, why query the place of publication, when it is clearly given on the title-page? Pp. 196-7—where the authors of anonymous works are known, they should be indicated. Thus the catalogue of the Ashmolean is by P. B. Duncan and the "Mémoire instructif" is by E. F. Turgot. On p. 604, what appears to be another copy of the latter work is catalogued under Turgot. P. 325—Dryander's catalogue of Banks's library is asserted to have "passed through half a dozen editions". Only one edition of this work was published. What is evidently referred to is the "Catalogus librorum qui desiderantur in bibliotheca J. Banks"—obviously another story. The entry under Banks on p. 220 is correct except that for 1798 read 1796. P. 430—the Dutch edition of Leeuwenhoeck is not a complete set of all his works, neither was he a physician. A number of his important contributions to the *Phil. Trans.* do not appear in the collected works, Dutch or Latin. P. 498—Oken's "Allgemeine Naturgeschichte" is interesting only as an example of the complete potboiler, but as a piece of zoological literature it is neither rare nor important. P. 520—the work catalogued under Pitfeild is not by this author but only translated by him. Nor is it correct to say that this work is not in the South Kensington catalogue, where it is to be found under "Paris", and Pitfeild's name, as usual, is incorrectly spelt. P. 589—"The Book of Nature" does not include Swammerdam's works on respiration and on the structure of the uterus, and does not therefore constitute his *Opera omnia*.

F. J. COLE.

A Modern Domesday Book

The Victoria History of the County of Kent. Edited by William Page. Vol. 3. Pp xv + 452 + 37 plates. (London: The St. Catherine Press, 1932.) 63*s*.

WITH the issue of the third volume, the general section of "The Victoria History of the County of Kent" is brought to a close; the remaining volumes, comprising the topography of the county, will deal with the history and topography of the individual parishes.

When a county has so much that is of moment to the archæologist and the historian, it may seem profitless to compare one volume with another. Each has its special attraction for different classes of reader. Here undoubtedly the most considerable contribution is the account of the Roman remains, which include the site of Richborough, of the first importance for the final phase of the Roman occupation. This has been completed by Dr. R. E. Mortimer Wheeler, partly from material which had been brought together by the late Prof. Haverfield and Miss Marjorie Taylor. Romano-British Kent, as a main line of communication with the Continent, is of exceptional interest. Dr. Wheeler's article in its combination of description and historical reconstruction is a model for the treatment of archæological material in a work on this scale and of this character. The somewhat disappointing material afforded by the Domesday survey, with which Prof. N. Nielson and the Rev. F. W. Ragg deal, is more than counterbalanced by the interesting "Domesday Monachorum", again the work of Prof. Nielson. Both Miss Maud Simkins, in her survey of the political history, and Dr. Gilbert Slater, on the social and economic conditions, handle their material with a due appreciation of its relation to the character and purpose of the whole work as a county record. In an informative account of the industries, Miss Ethel M. Hewett has included a history of the coal mining project which takes a hopeful view of its future prospects.

It may not be out of place to recall that the first volume of "The Victoria History of the County of Kent", which dealt mainly with natural history and archæology, appeared so long ago as 1908, while the second volume, of which the principal topic was ecclesiastical history, appeared in 1926. The long interval which has elapsed since the publication of the first volume is to be deplored; but it was inevitable in the unforeseen conditions which arose.

The "Victoria History of the Counties of England" was begun in 1899 under the general editorship of Sir Laurence Gomme and Mr. H. A. Doubleday and since 1902 has been in charge of Mr. William Page. It was dedicated to Queen Victoria, who commanded that it should bear her name, and it has been continued as a memorial of her. It was planned on a grand scale as a national historical survey which would be of permanent interest and value. It includes not only natural features, flora and fauna, antiquities, a new translation of Domesday Book, and political, social, and economic history, but also in each county, under the final section of topography, there is a detailed description and history of each parish, with an account of the land and its owners from the Conquest, or before, downwards. This section has entailed a research in manorial and family histories and records, in which no effort has been spared to secure that it should be exhaustive. This alone will make of the Victoria Histories a treasure-house of facts of much more than local significance. It is, however, no exaggeration to say that from any point of view the "Victoria History of the Counties of England" is a work of national importance.

When publication was interrupted at the outbreak of war in 1914, 71 volumes had been issued, and a large amount of material for future volumes had been prepared. That an undertaking of this magnitude and character should have been carried so far without assistance from outside reflects the greatest credit on editor, staff, contributors, and publisher. The increased cost of production after the War precluded the continuation of the work until the generous assistance of Viscount Hambleden enabled publication to be resumed in 1927. Unfortunately, this assistance is no longer available, and until support is obtained from other sources it will not be possible to carry on the preparation and issue of further volumes.

In view of what has been said as to the character of the work and the field it covers, it is abundantly evident that its continuation does not fall short of being a matter of national concern. Even if in present conditions help from the national exchequer is out of the question, the counties directly concerned might well assist, especially where attempts are being made to arouse interest in local history as part of the curriculum of the county schools. Perhaps this, too, may seem to take too optimistic a view. In that event, the work is such as should present a strong appeal to any one of our universities. Not only would a university which assumed responsibility for the Victoria County Histories, issuing the volumes through its university press, confer a lasting benefit on academic

studies in several branches of history and science, but it would also provide an exceptionally favourable field for its research workers in the collection and preparation for publication of material under the supervision of those departments of the university whose subjects come within the scope of the "History". Too much time, thought, and money have been expended on the work so far as it has gone for it to be allowed to come to premature end without some strenuous effort to secure its successful completion. Even if it be too much to expect in these difficult days that sufficient support for the completion of the work will be forthcoming, it is greatly to be hoped that steps will be taken to preserve for research purposes the vast amount of material which has been collected from original sources for various volumes of the "History" yet unpublished.

The Future of China

The Capital Question of China. By Lionel Curtis. Pp. xix + 322. (London: Macmillan and Co., Ltd., 1932.) 10*s.* 6*d.* net.

MR. LIONEL CURTIS has done a public service in writing this book. It treats of the plight of at least a fifth of the human race, to whose condition our past actions have demonstrably contributed. It traces the effects of a leaven of modern scientific thought, working in a society not socially or politically organised to receive it. It gives a short but adequate survey of the antecedents, and makes a few tentative suggestions for ameliorative action. Here, no doubt, the reader will feel the need of further guidance; but, as Mr. Curtis insists again and again, the first essential is that we in the West, and especially the British and American peoples, should take an increasing interest in the matter and inform ourselves as to the state of affairs.

This purpose the book admirably fulfils, and, as our more immediate concerns in the West become less harassing, we shall be able to turn with a calmer and more united mind to the even larger problems which the future of China unfolds. But every one should read the book without delay, if only to revive his memory of recent events and put them in the right setting of world-history at the most crucial meeting point of East and West. Three lines of contact have persisted since the middle ages and have been much extended in modern times: trade, which has led to the foreign concessions and 'unequal treaties'; religion, which has been steadily and heroically promoted by Christians of all sects, with good humanitarian results, but without increasing the political stability of the country; science, which in recent years has been eagerly studied by the élite of the younger generation, and is the strongest revolutionary force. All this has gone on without the political training which Rome afforded in the ancient world and England has given to India and other parts of the modern world.

Mr. Curtis deals briefly but fairly with the Manchurian question and the claims and recent actions of Japan. He stands firmly for the essential unity of China, and holds that Japan will live to regret her 'gunboat' policy. The two definite suggestions which he makes for British policy are: that we should set up our legation in close contact with the Chinese government, the place being somewhere in the Yangtze valley; secondly, that we should send out some one of full diplomatic standing and the highest personal qualifications to advise and co-operate with the Chinese central authorities. Cromer and Milner suggest to him the desirable type among English administrators; Dwight Morrow, whose work in Mexico had no proconsular touch, seems a nearer analogy. But the problems of Mexico are child's play in comparison; China is an ancient world thrown into chaos.

F. S. MARVIN.

Short Reviews

Witwatersrand Mining Practice. By Prof. G. A. Watermeyer and S. N. Hoffenberg. (Published by the Transvaal Chamber of Mines, Gold Producers' Committee.) Pp. xxxii + 895. (Johannesburg: Hortors, Ltd., 1932.) 45*s.*

THE Mines of the Witwatersrand have produced gold worth more than £1080 millions sterling, and their annual output is half the annual world production of gold. The underground practice of so important a field, which contains some of the deepest mines of the world, is of interest to all mining engineers, especially as within the last decade great advances have been made in underground working methods, as a result of exhaustive research by the mining groups.

This volume contains up-to-date descriptions of all branches of Rand underground practice. The aim of the authors has been to provide a work which would serve both as a reference book to the mining engineer and a textbook for the student. The first objective has been achieved, for the abundant technical data, the clear illustrations, and good index make the volume of great service to those wishing to keep abreast of modern underground practice on the Rand, without the inconvenience of consulting the transactions of a number of different technical societies. In order to serve as a textbook of mining with special

reference to Witwatersrand practice, many of the chapters have been provided with introductory matter to treat each subject in a connected manner. It is difficult to combine the amount of detail desirable for a handbook of reference with the breadth of treatment needed for a textbook. From the point of view of a textbook, the chapters on underground methods of working could have been improved by a broader review of the methods described. T. P.

Merchant Venturers in Bronze. By H. Peake and H. J. Fleure. (The Corridors of Time, 7.) Pp. viii + 168. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 5*s*. net.

IN "Merchant Venturers in Bronze" the authors of "The Corridors of Time" have now come to the early and middle bronze age. At the beginning of this period, somewhere about 1900 B.C., the fall of Hissarlik, as they interpret the evidence, caused a dislocation of the trading activities radiating from the Troad, but by no means interrupted the spread of a knowledge of bronze. The argument for the localised development of culture already put forward, in the case of outlying areas visited for the supply of metal, is here carried further in its application to western Europe.

The period covered, which extends over the greater part of the second millennium, is one of special interest, as it comprises not only the extension of the use of bronze in central Europe—of which the account given here may, perhaps, appear to make light of difficulties, though with some success—but it also embraces the great racial movements of the Aryans into India, the Kassites into Mesopotamia, and the Hyksos into Egypt. It has also to deal with the foundation of the Mycenæan civilisation and with the numerous problems to which the origin and early development of that civilisation gives rise, such as, for example, the chronological and cultural relation of the tholos tomb and the shaft-graves of Mycenæ, a problem for which an ingenious solution is suggested. The period is a maze of difficulties; and if the size of the volume precludes very detailed treatment, it does at least serve as a guide along the darker stages of the way.

Engineering Mechanics. By Prof. F. L. Brown. Pp. xi + 477. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 20*s*. net.

THE book is written from the point of view of the engineering student, and the applications of the principles of mechanics are treated conformably with engineering practice. Thus the examples are drawn from roof trusses, bridge girders, journal bearings, pump impellers, automobile engines, and the like. Applications in other directions are ignored as inappropriate. The subject matter is clearly expounded, with many well-executed diagrams which should render the text easy to assimilate. The usual ground is covered in two parts, the first dealing with statics and the second with kinematics and kinetics. The author makes a point of omitting any reference to the term 'mass' in the development of the last-named subject until after he has restated and explained Newton's Laws of Motion independently of it. Indeed, he avoids the use of the word throughout, urging that it is not essential to the elucidation of problems which particularly concern the engineer. Appended to each section of explanatory text is a selection of illustrative examples, with solutions or answers. With its modern instances, the book is thoroughly up to date, and should prove useful to the engineering student. B. C.

A Practical Manual of Lac Cultivation. By P. M. Glover. Pp. iv + 81 + 16 plates. (Nankum, Ranchi: The Indian Lac Association for Research, 1931.) n.p.

IN view of the importance of the lac industry to the Indian Empire, it is obviously desirable that the best practical information should be readily accessible to all who seek it. Mr. P. M. Glover, entomologist to the Indian Lac Research Institute at Ranchi, has produced an up-to-date guide to the subject, embodying the results of recent investigation carried out under the auspices of the Lac Research Institute, which will doubtlessly be welcomed by all the more progressive growers. The yield of the lac crop responds enormously to judicious inoculation and skilful cultivation, coupled with proper pruning of the host trees. Unfortunately, the lac insect itself has numerous enemies, and some of the most destructive are other insects of several kinds. The counteraction of the activities of such enemies is one of the most urgent problems that have to be faced, since they are responsible for the destruction of about sixty per cent of the crop produced in each year. These and other aspects of lac cultivation are discussed by Mr. Glover in his very practical guide to the subject.

Check-List of Birds of the World. By James Lee Peters. Vol. 1. Pp. xviii + 345. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1931.) 17*s*. 6*d*. net.

A SINGLE work giving a complete list of the birds of the world had not been published for more than thirty years, during which time very many new forms had been described and much revision had been made in classification and nomenclature. The list which Mr. Peters, of the Harvard Museum of Comparative Zoology, is compiling, and of which this is the first of ten volumes, will therefore be an invaluable work of reference for ornithologists if the remainder of the task can be accomplished without too great delay. The information given is restricted to the names of the genera, species, and sub-species, the authorities for these, abbreviated synonymies, and summaries of the distribution of each form. On many controversial points of nomenclature and validity the author has necessarily had to follow his own judgment, but apart from differences of opinion in this regard, there is likely to be little criticism of the way in which he has begun his great labour. The arrangement and the typography are admirably clear.

The Total Solar Eclipse of Aug. 31, 1932

By Prof. F. J. M. STRATTON

THE belt of totality of the solar eclipse of Aug. 31, 1932, starts north of Siberia, and, after passing within about 300 miles of the north pole, crosses Canada and New England, and ends in the middle of the Atlantic Ocean. In Canada the track runs from the southern end of Hudson Bay south-east across Quebec, the central line crossing the St. Lawrence River at Yamachiche, where there is a Marconi wireless station (Fig. 1). The south-westerly boundary of the belt of totality passes

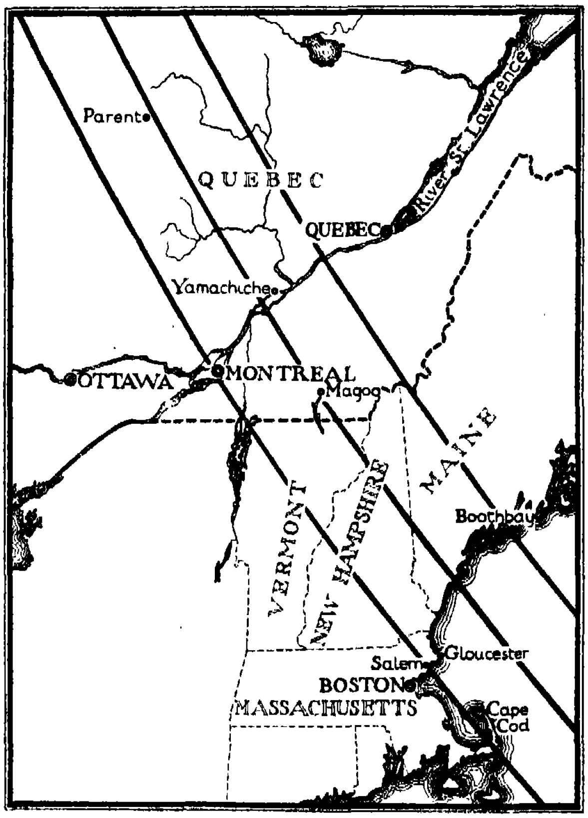

FIG. 1.—Track in Canada and New England of the total solar eclipse of Aug. 31, 1932.

through Montreal, and reaches the Atlantic coast between Salem and Gloucester; Boston is outside the belt, Cape Cod within it; the north-eastern boundary reaches the coast close to Boothbay in Maine.

Observations of the weather conditions between Aug. 16 and Sept. 14 at the hours of the eclipse have been made for a number of years at more than a hundred stations. Prof. F. Slocum, following Prof. D. Todd, has organised this work for the past five years and discussed the results (see NATURE, May 3, 1930, p. 673). There is no very marked difference between conditions in different sections of the track, and everything points to equal chances at any station that may be selected.

No details are available of the plans of the various American eclipse parties which will be distributed through Vermont, New Hampshire, and Maine, but it is understood that Prof. S. A. Mitchell, of the Leander McCormick Observatory, will be stationed at Magog in southern Quebec. Three British expeditions are being sent to Canada under the auspices of the Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society. Dr. J. Jackson and Mr. C. R. Davidson, from the Royal Observatory, Greenwich, will join Prof. Meldrum Stewart, of the Dominion Observatory, Ottawa, at Parent, a station on the Canadian National Railway north of the St. Lawrence River; Prof. H. Dingle, of the Imperial College of Science, will work at the Macdonald Physics Laboratory of McGill University in Montreal, on the edge of the eclipse belt; Prof. F. J. M. Stratton, Dr. R. O. Redman, and Mr. C. P. Butler, of the Solar Physics Observatory, Cambridge, with Prof. J. A. Carroll, of the University of Aberdeen, will be stationed at Magog in southern Quebec. They will be joined by Dr. J. S. Foster and Miss Douglass (and possibly several others) from McGill University, Prof. G. H. Henderson, of Dalhousie University, Dr. C. S. Beals, of the Victoria Observatory, and by several of those who are making the preliminary tour of Canadian and American observatories, organised by the assistant secretary of the Royal Astronomical Society; among others, the master of Caius, Dr. F. W. Aston, Dr. W. Hall, Dr. Haughton, Dr. H. Knox-Shaw, Dr. W. J. S. Lockyer, Dr. W. H. Steavenson, and Mr. A. D. Thackeray are expected to join the Cambridge party, and to help in the observations of the eclipse.

The programmes of the three British expeditions are as follows:

(1) The Greenwich expedition will take photographs of the corona with the 6-inch lens of 45 ft. focal length lent by Mr. Worthington for use at the eclipse at Alor Star in 1929. Objective prism spectra of the chromosphere and of the corona will be secured with a telescope of 7 in. aperture and 21 ft. focal length, with a 45° prism placed before the object-glass. The range of spectrum on a curved film will be from $\lambda 3600$ to $\lambda 6800$. A fourth attempt will be made — the previous attempts having been frustrated by bad weather conditions —to obtain a comparison of the intensities of the *H* and *K* lines with those of the Ca^+ triplet at $\lambda 8600$ at different heights in the chromosphere. The remaining instrument is to be a grating slit spectrograph, which will be used for a study of the spectrum of the chromosphere and corona from $\lambda 4500$ to $\lambda 9000$—the dispersion will be 17 A. to the mm. All the four instruments will be fed with beams from cœlostats.

(2) Prof. Dingle's objects at this eclipse are to study the bright line spectrum at the cusp with high dispersion, and the Fraunhofer spectrum at

the limb just before and just after totality. Prof. H. F. Newall and Prof. A. Fowler, from observations made in England at the eclipse of April 1912, showed what interesting results might be expected from observations of a nearly total eclipse or from observations at the edge of the belt of totality, confirming suggestions made by Mr. Evershed in 1903. Hitherto bad weather has frustrated all attempts to carry out such investigations, while the interest of the problem has only been increased by the study of spectral changes in wave-length at the sun's limb. Prof. Dingle is using a Littrow spectrograph with two 60° prisms backed by a plane Rowland grating (used in the first order), working with a 4 in. lens of 16 ft. focal length. The region of the spectrum to be examined will be λλ4200-4400, with an average dispersion of 0·6 A. per mm. The limb will be studied for about five minutes each side of totality, and the cusp for about half an hour beforehand and half an hour afterwards.

(3) The programme of the Cambridge expedition will be mainly a repetition of investigations prevented by clouds at the eclipses of 1927, 1929, in Norway, Siam, and Kedah. The polarisation of the corona will be studied by a double tube camera of 54 in. focal length, with a large nicol prism placed in front of one tube. The dependence of the polarisation on wave-length will be examined by a double-image one-prism spectrograph fed by an image-forming lens of 2 ft. focal length. The Hills quartz spectrograph will be used for a study of the ultra-violet spectrum of the chromosphere, with especial reference to the intensities at varying solar levels of the lines of the Balmer series and of the continuous spectrum at the head of the series. In the case of the corona, the chief study with this instrument will be the distribution of the radiation of the continuous spectrum. The results obtained with this spectrograph will be checked by a spectrum of different dispersion obtained from a 6 in. concave Rowland grating, used in the stigmatic position with a reflecting collimator. The range of spectrum to be covered will be λλ3200-4600.

The continuous spectrum of the outer corona will be studied with a 19-inch Common mirror of 50 in. focal length and a one-prism spectrograph with Aldis collimator and camera lenses of aperture 4 in. working at *f*/3. An objective interferometer will be used to study the wave-length of the green coronal line and movements in the coronal gases, in particular the rotation of the corona. The latter problem will also be attacked with the 4-prism spectrograph mounted on a polar-heliostat and used for that purpose by Prof. Newall in Sumatra in 1901.

A moving plate objective grating spectrograph with a slit in the focal plane radial to the sun's limb will be used for spectrophotometric study of the flash spectrum at different levels over the range λλ4100-4700. The grating will be a 6 in. plane grating fed by a Cooke photovisual lens of 6 in. aperture and 20 ft. focal length. A second objective grating will, it is hoped, be used for plates stained with xenocyanin and sensitive over the range λλ8600-10600, while a slit grating spectrograph will be used with plates stained with mesocyanin for the region centred at λ8600. The various instruments are being fed with beams from two cœlostats and Sir Francis McClean's 21-in. siderostat. The Hills siderostat will be used by the observers from McGill University for a grating spectrograph of high light-gathering power.

Finally, the 8 in. cœlostat of the Royal Irish Academy will feed the 4 in. lens of 19 ft. focal length lent by the same body, to secure direct photographs of the corona, and the 4 in. direct-vision prism of the Royal Observatory, Edinburgh, will be placed in front of the lens at the beginning and end of totality for objective-prism spectra of the flash, while Dr. Lockyer will take direct photographs of the corona with a camera lens of 4 in. aperture and 28 in. focal length.

The Lucasian Professors at Cambridge

THE Lucasian professorship of mathematics at the University of Cambridge, from which Sir Joseph Larmor retires at the end of September after holding it with distinction since 1903, is the third oldest chair of mathematics in Great Britain. The chair of geometry at Gresham College, London, was founded in 1596, the Savilian professorship of geometry at Oxford dates from 1619, while the Lucasian chair was founded in 1663, the same year in which the Royal Society received its second charter. It was founded through a bequest by Henry Lucas, who had studied at St. John's College, Cambridge, and after having served as secretary to the Earl of Holland, chancellor of the University, was elected to represent the University in Parliament. In his will he directed his executors to purchase land to the value of £100 a year to provide for the stipend of a professor of mathematics. Lucas died in London on July 22, 1663, and that same year the deeply learned and much travelled Rev. Isaac Barrow (1630–1677), already professor of Greek and Gresham professor of geometry, and afterwards master of Trinity, was elected first Lucasian professor.

Barrow took his duties seriously from the first, and immediately after his appointment, " the better to secure the End of so noble and useful a Foundation, he took Care that himself and his Successors should be obliged to leave, yearly, to the University ten written lectures ". His opening oration was delivered on March 14, 1664, and the lectures he gave during the next five years formed the substance of his " Lectiones Opticæ et Geometricæ ", 1669, and his " Lectiones Mathematicæ ", published six years after his death. But divinity had stronger claims for Barrow than even mathematics, and having already seen and acknowledged the superior abilities of his pupil Newton, in 1669 he resigned in his favour.

Newton was twenty-seven years of age when

he became Lucasian professor, and he held the chair for thirty-four years, until in 1703 he became president of the Royal Society. It is unnecessary to say that it was during his years at Cambridge that all his greatest discoveries were made and his greatest works published. Some of his discoveries were first made known through his lectures. "During his tenure of the professorship", says Ball, "it was Newton's practice to lecture publicly once a week, for from half an hour to an hour at a time, in one term of each year, probably dictating his lectures as rapidly as they could be taken down. . . . He never repeated a course, which usually consisted of nine or ten lectures. . . . The manuscripts of his lectures for seventeen out of the first eighteen years of his tenure are extant."

Newton was elected Parliamentary representative for the University of Cambridge in 1688, and after that lectured but little. In 1699 he made Whiston his deputy, and four years later Whiston was appointed to the chair.

With Newton's resignation and his removal to London, mathematical studies in Cambridge suffered a loss which the University felt for very many years. "Newton's burst of illumination", wrote the late Prof. H. H. Turner, "was followed by a dark century in Cambridge mathematics which is painful to contemplate." Yet in spite of this, the chair on which Newton had shed so much lustre continued to be held by men who at least had a deep reverence for his character and his work, and each of whom in his turn did something to advance the progress of science.

William Whiston (1667–1752), the first of the five occupants of the Lucasian chair during the eighteenth century, had graduated at Clare Hall and at the time of his appointment was rector of Lowestoft. Something of his activities can be gleaned from his own whimsical memoirs. As Lucasian professor he was instrumental in getting Roger Cotes (1682–1716) made the first Plumian professor of astronomy, declaring that in mathematics he "was but a child to Mr. Cotes", and in 1707 with Cotes he began a course of philosophical experiments. But Whiston's period of office was cut short through his religious views being held obnoxious by the authorities, and on Oct. 30, 1710, he was expelled from the University. The loss of £100 a year was, no doubt, felt severely, but thanks to Addison and Steele he was able to give astronomical lectures "at Mr. Button's Coffee house, near Covent Garden, to the agreeable entertainment of a good number of curious persons and the procuring me and my family some comfortable support under my banishment".

The choice of a successor to Whiston fell on Nicolas Saunderson (1682–1739), who through smallpox had been blind from the age of one, but who was described by one of his students as "a professor who had not the use of his own eyes, but taught others to use theirs". He was one of the earliest exponents of the Newtonian philosophy and, it is said, spent seven or eight hours a day in teaching. His "Elements of Algebra", compiled during the last six years of his life, has been referred to as "a model of careful exposition". John Colson (1680–1760), who succeeded Saunderson, was already fifty-nine when appointed to the chair; he had had as a competitor Demoivre, the intimate of Newton, who, however, was seventy-two, "almost as much fit for his coffin; he was a mere skeleton, nothing but skin and bone". In 1736, Colson had published a work on fluxions, and during the twenty-one years he held the Lucasian professorship he translated Nollet's work on experimental philosophy and Maria Gaetana Agnesi's "Istituzioni analitiche", but, said Cole, the Cambridge antiquarian, "the University was much disappointed in its expectations of a professor that was to give credit to it by his lectures".

When Colson died in 1760 at the age of eighty years, the example of Barrow and Newton was no longer followed, and neither Edward Waring (1734–1798) nor Isaac Milner (1751–1820), his successors, gave lectures or enriched the University with their writings. Waring was only twenty-five years of age when given the Lucasian chair. Afterwards he qualified in medicine and obtained a seat on the Board of Longitude, but his European fame was due to his "Miscellanea Analytica" and his contributions to the *Philosophical Transactions* of the Royal Society, for which in 1784 he was awarded the Copley Medal. Milner was both man of science and a divine, and became president of Queens' College, Cambridge, and Dean of Carlisle. Born in 1751, he was senior wrangler and Smith's prizeman in 1774, studied chemistry under Watson, and in 1783 became the first Jacksonian professor of natural philosophy. Resigning this post in 1792, "henceforth", it is said, "he gave up science in general except as an amusement". He had written works on motion, equations, the precession of the equinoxes, and natural philosophy, but after being appointed to the Lucasian chair on Waring's death in 1798, he contented himself with carrying out the minor duties of the post without doing any teaching.

It was while Milner held the chair that the writings and methods of the continental mathematicians began to be studied seriously at Cambridge, and with this came the reformation of mathematical studies not only in the University but also in the whole country. Foremost among the reformers was Robert Woodhouse (1773–1827), fellow of Caius College, who in 1803 published his "Principles of Analytical Calculations", and was chosen as Milner's successor in 1820. He held the chair for only two years, and within the next few years the chair was held by three different incumbents. From 1822 to 1826 it was occupied by Thomas Turton (1780–1864), a senior wrangler, who became professor of divinity, Bishop of Ely, and Dean of Westminster; during 1826–28 it was held by George Biddell Airy (1801–92), who vacated it to become Plumian professor of astronomy, a post he held until he was made Astronomer Royal; and in 1828 it was given to Charles Babbage (1792–1871).

With Herschel and Peacock, Babbage in 1813

had founded the Analytical Society at Cambridge, and in 1816 had translated Lacroix's "Traité élémentaire du calcul différentiel et du calcul intégral", thus ably furthering the movement begun by Woodhouse. It was the combined efforts of these four which paved the way for what has been called "the golden age of mathematics and physics at Cambridge". But, by 1828, Babbage was too deeply engrossed in his calculating machine to devote much time to the duties of a professor, and though he was sensible of the honour conferred upon him, "the only honour", he wrote, "I ever received in my own country", he contented himself with performing his duties as an examiner. As such he exerted considerable influence, and among the winners of Smith's prize examined by him was William Cavendish, afterwards Duke of Devonshire, chancellor of the University, and the founder of the Cavendish Laboratory.

Babbage held office for eleven years, when he was succeeded by Dr. Joshua King (1798-1857), who from 1832 until 1857 was president of Queens' College. By this time the new school of Cambridge mathematicians included many who were destined to become famous, and during the ten years Dr. King held the Lucasian chair, among the names of the senior wranglers and Smith's prize-winners were those of Ellis, Cayley, Adams, Todhunter, Kelvin, and Stokes, the last of whom in 1849, at the age of thirty, was chosen to succeed Dr. King. On the work of Sir George Gabriel Stokes (1819-1903), the immediate predecessor of Sir Joseph Larmor, it is unnecessary to dwell. During the fifty-four years of his tenure of the chair, he re-established the fame of the office once held by Barrow and Newton, and on the occasion of his scientific jubilee he was hailed as "the Newton of the nineteenth century".

Centenary of The British Medical Association *

THE British Medical Association, which is celebrating the centenary of its foundation at its annual meetings in London on July 21-29, is fortunate in having secured a chronicler worthy of the occasion in the person of Mr. Muirhead Little, who is not only a distinguished orthopædic surgeon but is also a well-known and accomplished writer on medical history. His work contains a very full and well-written description of the history of the British Medical Association and its multifarious activities during the last hundred years, together with an account of the leading personalities connected therewith.

Mr. Muirhead Little begins with a sketch of the medical profession in 1832, a year memorable not only for the foundation of the Provincial Medical and Surgical Association, as the British Medical Association was first called, but also for the first epidemic of Asiatic cholera in England, the Anatomy Act, and the First Reform Bill. In the absence of statistical information, the sciences of epidemiology and public health did not then exist, and indeed, until the passing of the Registration Act in 1836, there were no national statistics to justify any trustworthy conclusions. The profession as a whole was not organised, for there was no hard and fast line between the qualified and unqualified practitioner, and it was not until the Medical Act of 1858, which was almost entirely the work of the Association, that the great body of practitioners first received official recognition of their existence, and their importance to the State was acknowledged. The average medical practitioner in 1832 was a man of little culture or education, and there seems to have been ample justification for the unattractive picture of the contemporary medical student drawn by Dickens in "The Pickwick Papers" and by Thackeray in "Pendennis".

Dr. Charles Hastings, on the other hand, the founder of the Association, who was knighted in 1850, was a man of considerable abilities, some originality of mind, and great industry. At the early age of thirty-four years, he became the leading physician in Worcester, as well as being an eminent naturalist. In 1828 he founded the *Midland Medical and Surgical Reporter and Topographical and Statistical Journal*, which came to an end in 1832, being succeeded in 1840 by the *Provincial Medical and Surgical Journal*, the organ of the Association, which during the period 1832-40 had published only an annual volume of *Transactions*. It was not until 1856 that the Association, which had hitherto been known as the Provincial Medical and Surgical Association, received its present name, while its organ, which had been renamed the *Association Medical Journal* in 1853, was given its present title of the *British Medical Journal* at the beginning of 1857.

The scientific work of the Association, of which Mr. Muirhead Little gives a very full description, has formed an important part of its activities since its foundation. This work includes the discussion of scientific topics distributed over fourteen to twenty sections at its annual meetings; the dissemination of information in the *British Medical Journal* and the special journals, the *Archives of Disease in Childhood* and the *Journal of Neurology and Psychopathology*; the appointment from time to time of special committees to consider particular aspects of medical science; the arrangement of collective investigations throughout the profession; the award of scholarships, grants, and prizes; and the organisation of lectures, both among members of the profession and the lay public. Moreover, the local units, of which there are several hundreds, devote a great part of their energy to the consideration of scientific questions.

The work carried out by special scientific committees of the Association during the last fifty years includes reports on chloroform, the action of various drugs, the prevention of ophthalmia neonatorum,

* History of the British Medical Association, 1832-1932. Compiled by Ernest Muirhead Little. Pp. viii+342+29 plates. (London: British Medical Association, 1932.)

the early recognition of uterine cancer, the treatment of fractures, the question of rheumatic heart disease in childhood, maternity and child welfare work, tests for drunkenness, the causation of puerperal morbidity and mortality, psychoanalysis and mental deficiency. The subjects chosen for collective investigation have been chloroform, pneumonia, chorea, rheumatism, diphtheria, puerperal fever, the incidence of cancer and the history of its after-treatment.

As regards the work of the local units, it is noteworthy that whereas previously the formulation of a medico-political policy occupied most of their attention, of recent years they have devoted most of their energies to the consideration of scientific and clinical matters.

An important part in the scientific work of the Association is played by the library originally started by Mr. Ernest Hart, a former editor of the *British Medical Journal*, who made a nucleus collection of books from those sent him for review. Until fourteen years ago the library was available only for reference purposes, but since 1918 members have been allowed to borrow books and periodicals.

Although the account of the work of the Association in relation to medical reform, contract practice, and national health insurance may appear somewhat wearisome to the profane and even to some members of the profession not engaged in general practice, it should be borne in mind that it was mainly by the agency of the Association that not only the status and dignity of the profession in Great Britain were established, but also the interests of the general public were safeguarded.

Among other matters with which Mr. Muirhead Little deals are the work done by the Association on behalf of its members in the Services; its organisation of the profession in the War of 1914–18; its campaign against quackery, in which the publication of "Secret Remedies" and "More Secret Remedies" with their analyses of expensive but worthless nostrums was an important event; schemes of medical benevolence, and medical ethics. Short biographical sketches are included of some of those who devoted their energies to the growth and welfare of the Association, among the most notable being the two eminent surgeons, Sir Victor Horsley and Mr. Edmund Owen; the last two editors of the *British Medical Journal*, Mr. Ernest Hart and Sir Dawson Williams; Dr. Elizabeth Garrett Anderson, who took a large part in the admission of women to membership of the Association, and Prof. W. E. Dixon, the well-known pharmacologist, whose death we have recently had to deplore.

Mr. Muirhead Little has also included numerous excellent portraits of those who have deserved well of the Association during the last hundred years, including two of the founder, and views of the different buildings occupied by the Association in London and elsewhere. A list of the places of the annual meetings of the Association, with the names of the presidents and other principal officers, forms a useful appendix.

Obituary

Baron G. J. de Fejérváry

The death at Budapest of Baron de Fejérváry from heart-failure on June 2, after an operation for gall-stones on May 28, too early deprives zoological science of a worker rich in both accomplishment and promise, and his colleagues of a charming and helpful friend. He is mourned above all by a widow and two young children.

Geza Julius Fejérváry de Komlós-Keresztes was born at Budapest on June 25, 1894. On the completion of his university course, he entered the Hungarian National Museum in October 1916, and took up the study of reptiles and amphibians; in 1923 he was made curator of the herpetological section in the department of zoology, a post which he held until his death. Taking the degree of Ph.D. at Budapest in 1917, he became *privatdozent* for zoogeography at the R. Elizabeth University, Pécs, in 1921, and in February 1930 was appointed professor extraordinarius of zoology in that University. When the International Congress of Zoologists was held at Budapest in 1927, he served as recording secretary and afterwards edited its proceedings, tasks for which he was eminently fitted by his knowledge of the world, his courteous manners, and his facility in languages, which extended beyond the five world-tongues to Russian, Latin, and Greek. His own writings appeared in Hungarian, German, English, French, and Swiss publications.

While based naturally on his herpetological studies, Fejérváry's contributions to science, with their clearness and precision of statement, gave evidence of a wide philosophical outlook and a keen insight. He was interested in various problems of evolution and particularly in the question of its reversibility; thus in 1920 he published "Observations sur la loi de Dollo, . . ." (*Bull. Soc. Vaud. Sci. Nat.*); in 1924, "Remarks on Nopcsa's paper on Reversible and Irreversible Evolution" (*Arch. Naturgesch.*); in 1925, "Über Erscheinungen und Prinzipien der Reversibilität, . . ." (*Paläont. Z.*); also, in 1929, he criticised Sir Arthur Keith's presidential address to the British Association (*Biol. generalis*). Among the more important of his systematic and morphological papers were: "Contributions to a monograph on fossil Varanidæ and Megalanidæ" (*Ann. Mus. Nat. Hungar.*, **16**; 1918), "Die phyletische Bedeutung des Praehallux und vergleichend-osteologische Notizen über den Anuren-Tarsus" (*op. cit.*, **22**; 1925), ". . . on the primary and secondary dermal bones of the skull" (*Arch. Naturgesch.*, **90**, A; 1924).

In 1928, Fejérváry organised an expedition to Malta and the neighbouring islands to study questions of zoogeography; his report on this investigation was left incomplete, as also was an

extensive work on general zoology. It is to be hoped that some of the large mass of notes that remain may be in a state capable of publication.

BARON ERLAND NORDENSKIÖLD

WE regret to record the death of Baron Nils Erland Nordenskiöld, the Swedish ethnologist and explorer, which took place at Göteburg on July 5. Baron Erland Nordenskiöld, who was fifty-five years of age, was a member of a family already distinguished in the annals of exploration. He was the son of Baron Adolf Nordenskiöld, who discovered the North-East Passage, and a cousin of Prof. Otto Nordenskiöld, who led the Swedish Antarctic Expedition of 1902–3. He himself specialised in the investigation of the aboriginal cultures of America, and had travelled extensively among the native tribes, especially the less well-known, of both Central and South America, upon whom he had for long been recognised as the first authority.

The results of Nordenskiöld's investigations were embodied mainly in a series of "Comparative Ethnographic Studies", published in English, of which the first nine volumes, some in two parts, had appeared and others were in course of preparation. Of these, the most important was "The Copper and Bronze Ages in South America". Yet in dealing with the origin of American cultures and the problems of diffusion, the essential quality of his mind and its strict insistence on logical proof based upon a meticulous examination of the detailed evidence were best seen in his later publications, such as vols. 8 and 9 in the series, "Modifications of Indian Culture through Inventions and Loans" and "Origin of the Indian Civilizations of South America", the latter published in February last, in which he effectually vindicated the indigenous origin of certain important elements in Indian culture. He dealt with other aspects of the same problem in the Huxley Memorial Lecture delivered to the Royal Anthropological Institute in 1929, for which he received the Institute's Huxley Memorial Medal.

MR. G. H. HALLAM

THE death is announced of Mr. George Hanley Hallam, which took place at Tivoli on July 12. Mr. Hallam, who was in his eighty-sixth year, was a brilliant classical scholar. He was educated at Shrewsbury School and St. John's College, Cambridge, where he was bracketed Senior Classic in 1869, was Craven scholar, and won the Browne medals for a Greek ode twice and for a Latin ode. He was thereupon elected to a fellowship at St. John's College, and was appointed a master at Harrow in the following year. He retired in 1906.

Mr. Hallam had lived in Italy for many years and was keenly interested in the work of the British Schools of Archæology in Athens and in Rome, keeping in close touch with the latter through his friendship with the former director, the late Dr. Thomas Ashby, and the present director, Mr. Ian Richmond. He himself had a profound knowledge of the antiquities and topography of the Roman Campagna, and was a contributor to the *Journal of Roman Studies*. His most recent communication to that journal dealt with the tomb of a vestal virgin discovered at Tivoli in 1930; while another discovery, also at Tivoli, a fresco found in an underground tomb, was made the subject of interpretation in a contribution dealing with the cult of Hercules. Mr. Hallam's own residence at Tivoli was itself of considerable interest to archæologists, for it was a convent erected on the site of a Roman villa, reputed to be the actual villa which was a gift from Mæcenas to the poet Horace. On excavation, however, it proved to be more extensive than had been thought, and is now generally held to be the villa of Mæcenas himself.

Mr. Hallam's continued interest in Harrow and his belief in the educative value of a knowledge of Italian and Roman culture were recently shown by the foundation of an annual prize to enable an Harrovian to spend a few weeks in Italy.

MR. THOMAS BAT'A

THOMAS BAT'A, the distinguished and enlightened Czechoslovak manufacturer who met a tragic death in a flying disaster on July 12, just as he was leaving his aerodrome at Otrokovice in Moravia on a journey to Germany and England, was a leading Central European personality. From humble beginnings he built up one of the largest and most progressive leather goods concerns in the world. Through hard work, skill, and a thorough knowledge of all the details of the industry, he evolved the model establishment at Zlin, which has grown tenfold since the War, in order to accommodate his ever expanding undertakings. He was also responsible for the new educational buildings for the young and adult employees, and also for the up-to-date hospital and clinics which were at the disposal of townsfolk and others. Whilst he expected his workers to give their best service, he studied their interest in every way. He limited their duties to five days a week and encouraged them to improve their knowledge in their leisure, and anyone who showed ability or initiative obtained rapid promotion. He believed in strict discipline, but never expected anything from a worker that he was not prepared to accept himself.

Although Mr. Bat'a's energies seemed to be wholly devoted to industry, he found time for cultural pursuits and was an expert linguist. Czechoslovak educational and scientific institutes frequently received handsome donations from Mr Bat'a, and he provided funds for the excavations in Moravia which, a few years ago, revealed relics of a prehistoric settlement. Mr. Bat'a was fifty-six years of age.

News and Views

Jean Antoine Claude Chaptal, 1756–1832

WHEN on July 30, 1832—a century ago—Chaptal died at the age of seventy-six years, France lost a man of science and statesman who had, perhaps, done more to further the progress of the arts, industries, and manufactures of the country than any of his contemporaries. The son of a pharmacist, he was trained as a doctor, but it was chemistry which absorbed his attention, and it was as a chemical manufacturer that he first made a reputation. Born on June 4, 1756, at Nogaret, in the Department of Lozère, he graduated at Montpellier in 1777, and four years later was appointed to a newly founded chair of chemistry at the University there. With the fortune left by an uncle he established works for the manufacture of acids, alum, white-lead, and other commodities, and his success was such that in 1793 the Committee of Public Safety employed him with Berthollet and Monge to superintend the manufacture of munitions. Under Chaptal, the output of the Grenelle powder factory was raised to 1½ tons a day.

CHAPTAL became one of the first professors at the École Polytechnique, reorganised the Paris school of medicine, and after being made a Councillor of State, became Minister of the Interior. As such he energetically promoted trade schools, industrial exhibitions and chambers of commerce, and the construction of roads and improvements in public health. It was to Chaptal that Napoleon one day said, "I intend to make Paris the most beautiful capital in the world", and it was at Chaptal's suggestion that a canal was cut for bringing water to Paris from the River Ourcq. Though his loyalty to Napoleon afterwards led to his name being removed from the list of peers, he continued to work for the common good until loss of fortune and old age overtook him. Among his many books, that on chemistry applied to the arts, published in 1806, was translated into most of the languages of Europe, and long remained a valuable work of reference. His tomb is in the Père Lachaise, where so many eminent men of science are buried. He was a member of the Institut de France from 1816 onwards, and his *éloge* was delivered before the Academy of Sciences by Thenard.

Centenary of the British Medical Association

THE annual general meeting of the British Medical Association, which marks the official opening of the centenary meeting of the Association in London, will take place on July 23 at the Association's house in Tavistock Square, London. On July 24 a pilgrimage to Worcester has been arranged. In this city, in 1832, the project for an organised alliance of medical practitioners first took shape, under the guidance of Charles Hastings, who was born at Ludlow on Jan. 11, 1794. In the morning, Dr. W. G. Willoughby will unveil a plaque on a house in which Sir Charles Hastings formerly lived, the Mayor of Worcester assisting at the ceremony. An original portrait of Hastings (1839), by G. F. Faulkner, from the Board Room of the City Infirmary, will be handed over to the Association. From the house there will be a robed procession to the Cathedral to participate in a commemoration service, at which the sermon will be preached by Dr. E. W. Barnes, Bishop of Birmingham. A memorial window will be unveiled by the Right Hon. Lord Dawson of Penn. Lord Dawson will deliver his presidential address on July 26, at Queen's Hall, Langham Place, London, W.1. Next day the Lord Mayor and Corporation of London will hold a civic reception at Guildhall. A centenary dinner will take place at the Albert Hall, on July 28; Lord Dawson will preside and H.R.H. the Prince of Wales will be the principal guest. The clinical and scientific work of the meeting will be divided among twenty-four sections. In that devoted to the history of medicine (president, Dr. Charles Singer), in a discussion on various aspects of British medicine during the past hundred years, Sir Edward Sharpey-Schafer, the veteran physiologist, will open a discussion on the physiology of the period, while Dr. P. H. Manson-Bahr will open another dealing with tropical medicine. Personal letters and relics of British pioneers of tropical medicine will be shown by Dr. Manson-Bahr. A large number of Dominion and foreign guests is attending the centenary meeting.

Vienna Academy of Sciences

AT meetings of the Vienna Academy of Sciences held on May 30 and 31, Dr. Hans Molisch, emeritus professor of plant anatomy and physiology in the University of Vienna, was elected a vice-president, and Dr. Anton Eiselsberg, emeritus professor of surgery in the University of Vienna, was made an honorary member of the Academy. In addition to various Austrian members, the following foreign elections were made: Dr. Franz Kossmat, professor of geology in the University of Leipzig; Dr. E. B. Wilson, professor of biology at Columbia University; Dr. Michael Rostovtzeff, professor of ancient history and classical archæology at Yale University; Dr. Hugo Obermaier, professor of ancient history at the University of Madrid, and Dr. Norbert Krebs, professor of geography at the University of Berlin, to be corresponding foreign members; and Dr. Friedrich Meinecke, professor of history at the University of Berlin; Dr. Eduard Schwartz, professor of classical philology at the University of Munich, and Dr. Jakob Wackernagel, professor of classical philology at the University of Basle, to be honorary foreign members. The following awards of prizes were also announced: The Ignaz L. Lieben prize, jointly to Dr. Georg Koller for his work on the acids of lichens and Dr. Alois Zincke for his researches on perylene; the Haitinger prize to Dr. Otto Redlich for his investigations on the constitution of water and aqueous solutions; the Hansgirg prize to Dr. Hans Krumpholz for his determinations of the positions of double stars and comets; the Rudolf Wegscheider prize to Dr. Fritz Wessely for his work on glucosides, flavones, and natural coumarins;

and the Fritz Pregl prize to Dr. Moriz Niessner for his micro-analytical investigations on alloys.

Imperial Academy of Japan

AT a meeting of the Imperial Academy of Japan on May 10, annual medals and prizes were awarded to the following: Kyosuke Kindaichi for his studies on the Ainu epic "Yukar"; Kiyoo Wadati for his investigations on deep focus earthquakes; Ikutaro Hirai for his work on the cause of the meningitis-like disease frequently observed among Japanese suckling children; Tatuo Aida for genetical studies on the body colour of *Aplocheilus latipes*; Motojiro Matuyama for his geophysical investigations on gravity anomalies and magnetism of basaltic rocks; Shintaro Uda for research on ultra-short electro-magnetic waves. The Mendenhall Memorial Prize was awarded to Seishi Kikuchi for his studies on the diffraction of electron rays through thin mica plates.

Visceral Sense Organs

THE fourth Victor Horsley Memorial Lecture was delivered on July 20 in the Medical School of University College Hospital by Prof. E. D. Adrian, who discussed the "Visceral Sense Organs". The action of the sense organs in the lungs and in the great blood vessels can be studied by recording the nervous messages which they send to the brain stem, a method made possible by the use of valve amplification to magnify the electric changes in the sensory nerve fibres. The normal sensory discharges in the vagus and carotid sinus nerves were demonstrated by gramophone records in which the nerve impulses were converted into sounds varying in pitch with the frequency of the discharge. The sense organs in the lung resemble the muscle spindles, giving a rhythmic discharge of impulses so long as the tissues are stretched. In normal breathing the discharge only occurs at inspiration, but there are some endings which are excited by collapse of the lung, and these may be the cause of rapid breathing in pathological conditions. The sense organs in the aorta and sinus caroticus behave like those in the lung and give a faithful signal of the blood pressure. Both systems act as governors to keep the respiratory and vascular systems working within safe limits, and, as with all sense organs, their effect depends upon messages which are graded by changes in impulse frequency and in the number of units in action.

New Motor-Boat Record

ON July 18, Mr. Kaye Don, piloting Lord Wakefield's motor-boat *Miss England III*, twice broke the previous world's speed record for motor-boats. In his first attempt Mr. Don covered the measured mile in 35·4 sec. and 35·2 sec. (117·43 miles an hour), and in the second attempt his times were 34·4 sec. and 34·8 sec. (119·81 miles an hour). The previous record was set up by Mr. Garfield A. Wood, who achieved 111·71 miles an hour. Sir Henry Segrave's record on Lake Windermere when he was killed in 1930 was 98·96 miles an hour. *Miss England III* was designed and built by Messrs. John Thornycroft and Co., Ltd., at Hampton-on-Thames. It is a single-step vessel and is fitted with two propellers. The boat is fitted with two Schneider Trophy type supercharged Rolls-Royce engines, developing 2200 h.p. and consuming about five gallons of fuel a minute. The length of the hull of the boat is 35 ft., and the maximum beam is 9 ft. 6 in.

High Speed and Flight

A SERIES of comprehensive experiments upon the possibilities of high-speed flight has been carried out in the Langley Field High Speed Wind Tunnel of the National Advisory Committee for Aeronautics in the U.S.A. Air speeds up to 800 miles an hour, which is faster than the speed of sound, have been reached. It has been definitely established that with the present conventional form of wing section there is so great an increase in drag at about 600 miles an hour that it will be impossible to carry sufficient power to overcome it, assuming the present methods of conversion of fuel to air thrust. This is confirmed by experience with high-speed propellers, the blade tips of which may easily be travelling at a peripheral speed approaching the velocity of sound. In such cases their outer portions may be actually exerting a negative effect. The delicate mechanisms of the human body do not appear to be susceptible to steady high speeds, but they react to accelerations at much lower figures. This case arises often during flight, when every turn is an angular acceleration. It has been established that the maximum speed that the human body can stand during an average sharp turn is about 300 miles per hour. The present speed record for flight in a straight line is an average 408·8 miles an hour, although speeds up to 415·2 miles an hour for short periods have been recorded.

Constitutional Tendencies in the Orient

AT a time when a bold experiment in the method of governing India is to be made and the details of the new federal constitution are being elaborated, a thoughtful paper by Sir Arnold Wilson, in the *English Review* for May, on the relative merits of government by means of an executive responsible to an elected body and by bureaucratic methods, should be read. As is well known, the application of the democratic principle to Eastern conditions is by no means new. It has already been attempted, not only in the management of local affairs in India itself, but also in a wider field in other countries, such as Turkey, Egypt, Persia, Iraq, Cyprus, Ceylon, and the Dutch East Indies. The results so far obtained are described in detail in the paper under review. They make very melancholy reading. In these very different localities, the introduction of the electoral principle has almost without exception either ended in complete failure or has been disappointing. On the other hand, in the overseas possessions of France and Italy, where the system adopted is a benevolent autocracy, the people are said to be contented and there is little or no unrest of the type now so common throughout India.

The Indian Problem

IT is difficult to resist the conclusion that had the Indian problem been approached at the very outset by the methods familiar to the man of science, one of

the first tasks would have been a careful study of the literature of the subject and particularly of the results already obtained from the experiments in the art of ruling which have been made in other countries. This procedure, however, does not appear to have been followed. Even the Commission which recently worked under the able guidance of Sir John Simon was not empowered to study constitutional developments in other Asiatic countries, otherwise " they might well have hesitated before recommending even a moderate extension of the franchise". The matter, however, has gone too far for such studies to be undertaken. The new constitution will shortly be established: the results will soon be clear to all. If it succeeds, all criticism will be laid to rest by the one unanswerable argument—success. If it fails, a new Indian Civil Service, in which it is hoped that science will take its proper place, will have to be re-established.

A High-Efficiency Gaseous Lamp

Messrs. Philips Lamps, Ltd., are introducing a new lamp which has an efficiency of about eight times that of a gas-filled lamp taking the same power. A description of the lamp is given in the *Electrical Times* for July 14. In the new lamp an electric discharge passes through a rare gas ' filling ' with a small quantity of metallic sodium. There is an oxide cathode with one or two anodes. The bulb of the lamp is in the shape of a cylinder, which has to be heated up to a certain temperature sufficient to vaporise the sodium. The lamp is enclosed in a second cylinder, which accelerates the heating and keeps the temperature constant. The discharge and consequently the emission of light depend mainly on the sodium vapour. The colour of the light is yellow and practically monochromatic. This colour is favourable to good visibility and therefore the lamp is very suitable for street lighting. A photograph taken at night is shown of a long length of road in Holland illuminated by the new gaseous lamps. It has been noticed that drivers of fast cars when entering the newly lighted part of the road switched off their headlights unasked. Hence there is no ' dazzle ', the elimination of which is one of the greatest problems of night driving. The candle-power of the lamps is 500-600 for the smallest size made, which take 100 watts. These lamps will be useful where colour is of minor importance. For domestic use a whiter light is more desirable.

Modern Developments in Precision Clocks

The most accurate timekeepers of to-day are divided into two classes, depending on whether the restoring force of the oscillator is gravity, as in pendulum clocks, or elasticity, as in quartz crystal oscillators. In a monograph by A. L. Loomis and W. A. Marrison on precision clocks, published in the *Transactions of the American Institute of Electrical Engineers*, an account is given of the performance of a set of 100,000-cycle quartz oscillators built by the Bell Telephone Laboratories for use as a primary frequency standard. The frequency of quartz oscillators is practically independent of the amplitude. They are not affected by gravity or magnetic fields and can be easily shielded from electrostatic fields. They are practically unaffected by heavy traffic in neighbouring roads or by the vibrations near earthquake zones. A crystal clock standard is more costly than a pendulum clock of the highest precision, but it can be used for many purposes. For example, an absolute comparison of crystal clocks can be made with an error of less than one hundred-thousandth part of a second, and can be maintained continuously. For short time comparisons an inaccuracy not greater than 1 in 10^{10} has been obtained. The high accuracy of comparison is due chiefly to the fact that the number of vibrations is 200,000 times greater than with a ' seconds ' pendulum. A comparison made of the data obtained by observing the difference in the rates of a crystal clock and three pendulum clocks revealed for the first time a lunar day variation. This is due to the fact that the crystal does not respond to variations in the gravitational effect of the moon, while the pendulum does. The difference in the rates of the clock and the crystal timekeeper thus contains a term depending on the period of the lunar day.

Jubilee of the Ferranti Works

The late Dr. S. Z. de Ferranti at the age of eighteen was the principal founder of the original company of Ferranti, Thomson and Ince in Charterhouse Square, London, in 1882. It is a little difficult to realise that there was then a great demand for electric meters. Messrs. Ferranti, Ltd., now of Hollinwood, Manchester, held an exhibition at Bush House, London, during June to commemorate their jubilee. The fifty years' life-story of the firm shown by the historical exhibits is largely a history of the development of public electricity supply. A particularly interesting exhibit was the earliest models of Ferranti meters, some of which have only recently been taken out of service. The new methods of hardening the pivots and burnishing them so as to get the exact shape with the help of a micrometer jewel examiner with a powerful microscope were shown in action. New devices rendered necessary by the 132-kilovolt grid scheme in Great Britain were shown in action. An even more recent development is the manufacture of electric clocks, which are now made quite cheaply, of all sizes and shapes with cases of bakelite, wood, or metal. A prominent feature of the radio exhibit was a new seven-valve receiving set. A full range of water heaters and fires were shown. A working model of the Ferranti hot-water system for a house employing those heaters was shown. The ' Era ' fire which Ferranti's make is said to be ideal for devices for hatching chickens (chicken brooders). The machines used at the Ferranti works in Hollinwood are of the most modern design, and employ more than five thousand workmen.

Tuberculosis in England and Wales

The Report on Tuberculosis by Dr. A. S. MacNalty to the Ministry of Health (Reps. on Pub. Health and Med. Subjects, No. 64. H.M. Stationery Office. 3*s*. net.) may be regarded as an ' audit ' of the present position of the tuberculosis question in Great Britain. Tuberculosis is a disease not only of medical interest but also of wide sociological and economic importance. Anti-tuberculosis measures cost the country a great deal; for example, some 2½ million

pounds are expended annually on the maintenance of residential institutions for treatment. During twenty years of anti-tuberculosis campaign, the decline in the mortality from the disease has been striking—from a total of 53,120 deaths in 1911 to 35,745 in 1930. One of the most interesting and important sections of this Report deals with the results of sanatorium treatment. This is very difficult to evaluate, for the ultimate result depends so much on a variety of factors, such as (1) the type of the disease—some cases progress to a fatal issue in spite of all treatment, (2) the social position and sex of the patients, (3) the stage of the disease when treatment is commenced, (4) the age of the patients—pulmonary tuberculosis in the young adult tends to shorten life much more markedly than when it occurs in or after middle life, (5) the circumstances of the patient after discharge—the character of his home surroundings, his own care of his health, the nature of his occupation, and the like. It is concluded that some fifty-seven per cent of male and sixty-seven per cent of female patients in the second stage of pulmonary tuberculosis survive, often with good working capacity, for five years or more; a result which fully justifies the provision of sanatorium treatment. Much important information is embodied in this Report upon such subjects as after-care and village settlements for the tuberculous, methods of diagnosis, and special forms of medical and surgical treatment.

Science in the 'Sixties

A pamphlet with this title by Sir Oliver Lodge forms one of a series edited by Mr. John Drinkwater and addressed to men of letters. In it Sir Oliver contrasts the indifference displayed by the public and the Press to scientific discoveries made in the 'sixties with the universal interest shown at the present time in such subjects as relativity and the constitution of the stars. For the science of the 'sixties, Sir Oliver confines himself almost entirely to the theory of the electromagnetic field brought forward by Maxwell as the mathematical interpretation of Faraday's lines of force. He uses the words 'juggled with' to describe the process by which Maxwell evolved the electromagnetic theory of light from his mathematical expressions. This seems to us an unfortunate choice of words, likely to produce a wrong impression on the minds of readers. The steady progress from Maxwell to present-day wireless is outlined, and Sir Oliver concludes by giving his opinions on current theories. The new doctrine of uncertainty he summarises in "the act of *observing* carries with it inevitably an act of *perturbing*", but he denies that this renders events unpredictable. By 'faith' only does he accept relativity, but wave mechanics "is a healthy infant of great promise".

Scientific Apparatus of Historical Importance

SEVERAL daily newspapers recently published a letter from the Institute of Physics over the signatures of Lord Rutherford and others asking for the co-operation of anyone possessing pieces of apparatus likely to be of historical importance. In 1925 the Institute of Physics appointed a committee to advise on the preservation of such apparatus. This committee is anxious to trace any pieces with which fundamental research in physical science has been carried out, and to arrange for their preservation. The committee has also entered upon the task of drawing up a catalogue of such pieces. Several pieces of great historical importance have already been secured for the nation and are now housed in the Science Museum at South Kensington, and the response to the recent letter has brought to light several other important pieces. Articles describing and cataloguing such pieces are published from time to time in the *Journal of Scientific Instruments*. Many readers of NATURE may have such apparatus in their possession or under their charge; and the Secretary of the Institute of Physics, 1 Lowther Gardens, Exhibition Road, London, S.W.7, will be grateful for any information that will assist in tracing such pieces or in completing the catalogue. For the benefit of future historians of physical science it is desirable to have as complete a record as is possible of the work of British physicists, and it is to this end that this task has been undertaken.

Cremation and Population

MRS. ALEC-TWEEDIE'S address on "Cremation the World Over" at the Cremation Conference, which was held at Brighton on July 18-21, reinforced a strong appeal for the wider adoption of this method of disposal of the dead by reference to the distribution of the custom of burning the dead among peoples of antiquity and non-European races. She dwelt in particular on the practice of cremation among the Hindus, contrasting it in detail with the methods of burial among the Chinese, and pointing out how among the latter reverence for the last resting-places of the dead, where land enclosing burial mounds is under cultivation, hampers agriculture and is an increasing menace to food supply among a teeming population which already produces barely enough for its needs. The vastness of the population, it might be added, makes the practice increasingly detrimental from the point of view of hygiene. Although Mrs. Tweedie did not hesitate to make use of the appeal to the emotion which reflection on the conditions and consequences of inhumation never fails to arouse, a marked feature of her address was the emphasis with which she stressed the import of cremation as a factor in the world's population problem, linking it up with food supply and birth control in relation to over-population. As she put it in her closing words, "Without birth control and world cremation, what will the end be?" Mrs. Alec-Tweedie was the first and only woman on the council of the Cremation Society of England for more than ten years. She is the daughter of the late Dr. George Harley, F.R.S., of Harley Street, and her brother was Dr. Vaughan Harley. Her brother-in-law is Dr. Francis Goodbody, who has done much work for the centenary meeting of the British Medical Association.

Population of London

THE volume of the Census, 1931, which covers the County of London has been published (London: H.M. Stationery Office, 3s. net). The total population enumerated in the City of London and the twenty-

eight Metropolitan Boroughs comprising the Administrative County of London on the night of April 26/27, 1931, numbered 4,397,003 persons. The males and females were respectively 2,044,108 and 2,352,895, a ratio of 1151 females per 1000 males. For the third decennium in succession, the County population shows a decline, the loss during the past ntercensal period being 87,520, a number comparable with the population of a good-sized town like Ipswich or Wigan. The number of private families has increased by 6·17 per cent, and the average size of the family has been reduced by 8·7 per cent, to 3·46 persons. With the reduction in the average size of the family, the average number of persons for each occupied room has declined from 1·05 in 1921 to 0·98 in 1931; that is to say, on an average there is less overcrowding. In Greater London, which occupies roughly a circle of 15 miles radius with Charing Cross as a centre, 8,203,942 persons were enumerated, or more than one-fifth of the total population of England and Wales.

Forecasting Mortality

IN a lecture to the Norwegian Actuarial Society printed in the *Skandinavisk Aktuarietidskrift*, Mr. Palin Elderton takes up the fascinating subject of forecasting mortality. Most medical statisticians and actuaries, if only for their private amusement, have tried their hands at prophecy. The most obvious line of approach, when rates of mortality in age groups are available over a long series of calendar years, is to take each group separately and to study the form of secular change, then, having more or less successfully represented the trend by some mathematical function, to extrapolate horizontally. As Mr. Elderton points out, this method would be inappropriate if changes in mortality at a later age are really determined by the experience through which the generation of which those at the later age are survivors have passed. In that case, one should consider not the horizontal but the diagonal progression of the table.

Prehistoric Chronology

AT the request of the editor of *Antiquity*, Mr. Miles C. Burkitt and Prof. V. Gordon Childe have prepared a chronological table of prehistory, which is published in the June number of that periodical. The progress of recent research in prehistory will secure a welcome for the chart among students, not least perhaps because of the decisive manner necessitated by its form in dealing with controversial points, which should at least be provocative of fruitful discussion. The compilers have found that a task which they anticipated would give rise to no great difficulty has proved of no little complexity. Failing the ideal method of distribution maps, it was found most practical to divide the map into several geographical areas, each of which heads a column in the list. Even so, the area of extent of specific cultures has sometimes been difficult to determine and represent. It has been found impracticable to give an absolute chronology much before 2000 B.C. In glacial chronology most of the Mousterian is taken as contemporary with Würm ii, Acheulean with Riss-Würm, and Chellean with Mindel-Riss, while pre-Chellean is definitely pre-Mindel. Even when allowance is made for local specialisation and retardation, and when a solar chronology becomes possible with the dated monuments of Egypt and Mesopotamia, difficulties have still to be overcome, as witness the correlations here put forward between Egypt and Mesopotamia, which, it is admitted, are not universally accepted. The chronological chart, with explanatory notes on each section and index, has been reprinted and is obtainable separately, price 2*s.* 6*d.*, from the assistant editor of *Antiquity*, 24 Parkend Road, Gloucester.

Re-opening of the South African Museum

ON June 1 the Governor-General of the Union of South Africa, the Earl of Clarendon, opened the reconstructed South African Museum in Cape Town, and so marked the accomplishment of an instalment of the development scheme of the trustees. The Museum, founded as a Cape Government institution in 1885, was housed in a new building in 1897, but had seriously outgrown the accommodation there. The present additions permit of a running sequence in the exhibits of different sections, and have given new opportunities for the proper display of some of the treasures the Museum possesses. The additions, on two stories, consist of the old Art Gallery and an entirely new block on the opposite or Avenue side, forming two large halls, 90 feet long by about 35 feet wide. The lower of these is devoted to ethnology, and here the famous life-casts of native races have found a fitting place; the upper contains the big-game collection, and the opening is marked by the addition of a new group of springbok. The trustees and Dr. Leonard Gill have made a notable contribution to museum progress in the Union.

Albinism in Wild Animals

A VERY interesting specimen recently received at the London Zoological Gardens is a young albino reticulated python. Its eyes are pink, but the usual markings are present in orange-colour on the white skin. Albinism seems to be very rare in cold-blooded animals, but a few years ago the Gardens exhibited an albino cobra, and many years before that an albino common frog. The albino form of the axolotl, of which specimens can be seen in the aquarium, is bred in domestication like the ordinary black form, but all such specimens appear to have descended from one albino which came in the first consignment of live axolotls received in Europe during the last century. Albino or 'silver' goldfish are well known, and in the Zoological Society's aquarium can be seen white as well as golden specimens of common carp; but these, again, are domesticated. Neither white axolotls, white goldfish, nor white carp have pink eyes, and so fall short of complete albinism. It has been noticed in birds that an albino or lutino specimen, if pink-eyed, retains its abnormal hue, but if normal-eyed, is liable to revert to type on moulting.

Modifying Broadcasting Voices

IN a broadcast talk given in America by O. H. Caldwell, the editor of *Electronics*, a method of improving the voices of some of the political speakers was described. By using a suitable combination of

electrical devices in connexion with the microphone, it is possible to improve the broadcast voice by smoothing out rough and strengthening weak notes. Sounds sent over the radio can be varied by placing in the broadcasting circuit filters, compensators, and amplifiers so that the frequency and volume are permanently varied or are left to be varied at the discretion of the control engineer. High-pitched voices are transmitted much better than deep voices over the radio. It was suggested that by putting different compensators in various branches of the broadcasting networks it would be possible for a political candidate to talk with the appropriate accent in several States simultaneously.

Standardisation at the Ottawa Conference

THE question of industrial standardisation will again come before the Imperial Conference when it meets in Ottawa at the end of this month, and Mr. C. le Maistre, director of the British Standards Institution, has been appointed adviser to the delegation from Great Britain on British standards. It will be recalled that at the last two Imperial Conferences very great importance was attached to the development of inter-Empire standardisation, and to the preparation of national industrial specifications by national standardising bodies. In order to fulfil the recommendation of the last Imperial Conference, the British Engineering Standards Association recently widened its scope, and is now known as the British Standards Institution. Since last November, Mr. le Maistre has been touring the Dominions in connexion with the development of this work.

New Deposits of Tin in the U.S.S.R.

THE expedition of the Soviet Academy of Science under the direction of Dr. A. E. Fersman has discovered new deposits of tinstone in Tadjikistan, to the north-east of Stalinabad. The Soviet Union so far has not had its own supply of tin ore, the working of the two deposits in Transbaikalia having only just commenced. The discovery of new rich deposits of tinstone is of great importance to the national economy of the U.S.S.R., particularly in the manufacture of tins for preserved foods, in the motor tractor industry, in the production of steam engines, etc.

Announcements

THE REV. J. P. ROWLAND, *S.J.*, has been appointed director of the Stonyhurst College Observatory, in succession to the Rev. E. D. O'Connor, *S.J.*, who has been appointed rector of the College.

AT the quarterly meeting of the Royal College of Surgeons held on July 14, Sir H. J. Waring was elected president of the College in succession to Lord Moynihan. The Lister Memorial lecture of the College will be delivered by Sir Charles Ballance on April 5, 1933.

THE following officers have been elected to the Council of the Institution of Electrical Engineers for the year 1932–33, to take office on Sept. 30:—*President*, Prof. E. W. Marchant; *Vice-President*, Mr. H. T. Young; *Hon. Treasurer*, Mr. P. Rosling; *Ordinary Members of Council*, Prof. J. K. Catterson-Smith, Mr. A. P. M. Fleming, Mr. H. W. H. Richards, and Mr. W. S. Burge.

AT the annual general meeting of the British Association of Research for the Cocoa, Chocolate, Sugar Confectionery, and Jam Trades, which was held on July 5, Mr. J. G. Mathieson was re-elected president and Mr. A. W. Beach and Mr. C. E. Southwell were re-elected vice-presidents.

IT is announced that by the will of Mr. James M. G. Prophit, a sum of about £120,000 is to be divided equally for the purposes of cancer and tuberculosis research. The tuberculosis moiety has been allocated to various hospitals and colleges, including the Royal College of Physicians, and to two studentships. The cancer moiety has been allocated chiefly to the Royal College of Surgeons, the Radium Institute, the British Empire Cancer Campaign, and also to two studentships.

THE ninth Annual Conference of the Association of Special Libraries and Information Bureaux will be held at Somerville College, Oxford, on Sept. 23–26. The presidential address will be delivered by Sir Charles Sherrington on Sept. 23. Among the papers to be read at the Conference are: "The Relationship between Science and the Humanities", by Prof. J. L. Myers; "Classified Subject Indexes to Periodical Volumes", by Dr. S. C. Bradford and Prof. A. F. C. Pollard; and "History and Sources of Official Vital Statistics", by Prof. M. Greenwood. Particulars of the Conference can be obtained from the General Secretary, Association of Special Libraries and Information Bureaux, 16 Russell Square, London, W.C.1.

MESSRS. W. Heffer and Sons, Ltd., have issued a catalogue (No. 390) of publishers' 'overstocks', or 'remainders' as they are more generally termed. All books are new and are offered at about half the published price or less. We notice in the section of reference books sets of Millais' "Mammals of Great Britain and Ireland" and Thorburn's "British Mammals".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A part-time lecturer in the Biology Department at the Plymouth and Devonport Technical College—The Secretary for Education, Education Offices, Rowe Street, Plymouth (July 23). A lecturer in mathematics at the Portsmouth Municipal College—The Registrar (July 29). A resident engineer in the Public Works Department, Hydro-Electric Branch, of the Government of the Punjab—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Aug. 4). An assistant teacher of mechanical engineering and an assistant teacher in the Nautical College at the Central Technical School, Byrom Street, Liverpool—The Director of Education, 14 Sir Thomas Street, Liverpool (Aug. 8). A full-time secretary to the Museums Association—The Secretary, Museums Association, 39B Alfred Place, South Kensington, London (Aug. 10). A junior assistant in the Directorate of Ballistics Research, Research Department, Woolwich, S.E.18.—The Chief Superintendent. A physics laboratory assistant at the Radium Therapy Department, Duke of York Home, Bradford.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Inheritance of Acquired Characters

IN making my final reply to Prof. Haldane, whose letter appeared in NATURE of July 2, I am actuated mainly by two motives, namely: (1) to try to dispel the mist of mental confusion in which Prof. Haldane is enveloped with regard to 'selection', and (2) to prove to readers of NATURE the baselessness of Prof. Haldane's attempts to discredit the evidence for the inheritance of habit given in my Royal Institution discourse.

I think that my first object can best be attained by referring to a somewhat similar controversy which I conducted some years ago with Prof. Julian Huxley, for whom, as a zoologist, I have a great respect, although I differ widely from some of his conclusions. I then stated the case for the inheritance of habit somewhat as follows: the ordinary routine experiment practised by Mendelians of crossing the races of domestic animals, such as mice and guinea-pigs, is one which requires no particular skill to carry out. If continued to all eternity it would throw no light whatever on the inheritance of habit: to test this, a special form of experiment is necessary, infinitely more difficult to carry out than the Mendelian one and requiring far more time for its execution. We must discover a species of animal sufficiently plastic in its constitution to respond within the period of its lifetime to a change in environment by some observable change in structure or behaviour: we must then breed from the altered individuals and examine whether some trace of the alteration is transmitted to the next generation, in spite of the fact that this generation has been returned to the typical environment. But Prof. Haldane objects that if we do this we are 'selecting'; yet what else can we do? The question at issue is whether an acquired habit is inherited. How can we test this except by breeding from animals which have acquired the habit? Perhaps Prof. Haldane means that not all of the individuals exposed to the new environment respond equally to it, and that those which do respond owe their power to something queer 'turning up' by accident in their constitution. It is in general true that whenever we expose animals to any set of new conditions we do not get a uniform response on the part of all, but a series of responses graded in intensity. This has been noticed by all workers in this field. Long ago Kammerer observed that only his most vigorous salamanders responded adequately to the colour of the background. This variation in response, however, is not due to mysterious 'genes' turning up, but solely to differences in vigour.

Coming now to my second object, I maintain that Prof. Haldane's assertion that all that Dürken obtained was gained by the selection of a race of green pupæ from a mixed population is without foundation. The 'green pupæ' are merely the end terms in a graded series of pigment reduction which occurs as a reaction to orange light, and the population is not mixed. The critical question is whether this reaction affects the reactions of their descendants—and this Dürken has proved up to the hilt. From 33 to 50 per cent of the next generation retain the lack of pigment in spite of an exposure to ordinary daylight. As I mentioned in my previous letter, Dürken in one of his later experiments obtained practically a 100 per cent response from a population exposed to an orange light, but this is rare. To all those, however, who wish to follow up this subject further, I recommend a perusal of the relevant passages in Dürken's book, "Grundriss der Entwicklungsmechanik". They will there find the questions of 'mixed populations' and 'selection' considered and decided in the negative, and they will be in a position to judge of the exact value of Prof. Haldane's statements.

We now come to the experiments of Metalnikoff. In my Royal Institution discourse I quoted from a review of Metalnikoff's work in a French scientific journal. Since then, however, we have taken up seriously the question of repeating Metalnikoff's experiments in my laboratory: we have obtained all Metalnikoff's publications, including the book in which he describes his experiments not only with the cholera bacillus but also with a number of other bacilli, and there is not a shadow of a doubt that Metalnikoff did not breed from the survivors of the individuals inoculated with the bacillus but from those immunised with the vaccine. Refreshing my memory the other day, I find that in one culture in the tenth generation of immunised insects 77 per cent of the individuals inoculated with the bacillus survived.

Here I should like to put on record my deep feelings of gratitude to Dr. Ledingham and his colleagues of the Lister Institute who have helped us by supplying standardised cultures of bacilli every time we wish to make an experiment. So far as I could discover, Dr. Ledingham and his colleagues were the only people in London who knew of and appreciated Metalnikoff's work. Whether we shall succeed in obtaining the same results as Metalnikoff remains to be seen.

I now come to Prof. Haldane's comments upon Prof. Heslop Harrison's experiments with the sawfly *Pontania salicis*. He suggested in his discourse that Harrison's strain of sawflies had become contaminated with a strain adapted to the new willow: that these individuals survived, and that so a false appearance of the artificial production of a new habit was created. To this I replied that the "new willow" was a rare hybrid; and that the idea of the sawflies becoming contaminated with a strain adapted to this willow was mere hypothesis. It must have been obvious to all readers that I had obtained these facts from Prof. Harrison, but in his letter Prof. Haldane directly challenges them, which seems a rash proceeding, considering that Prof. Harrison occupies a chair of botany and is unrivalled for his knowledge of the systematics and ecology of the British flora. Prof. Haldane asserts that the so-called rare hybrid is economically important and is cultivated in 69 vice-counties, whereas the unimportant original host-plant only grew in 34 vice-counties. I referred the matter to Prof. Harrison, and received from him a reply which disposes completely of Prof. Haldane's objections.

As I gave a list of eminent authorities who had become converted to Lamarckism, Prof. Haldane quotes against me the Royal Society motto, "Nullius in verba". As I am a fellow of that Society of twenty-seven years' standing, this was a superfluous attention on the part of Prof. Haldane. Of course, I accept it. Opinions *qua* opinions prove nothing, but this is not a fair way of stating the case. In a subject of the vast extent of zoology, the life-long efforts of one investigator can only enable him to cultivate *in detail* one limited part of the field, and yet it is precisely on this *detailed* study that the solution of all the major problems of the science depend. In my discourse I referred to three types of such detailed studies, namely, systematics, embryology, and palæontology. Nineteenth century morphology was only suggestive, not

demonstrative, because the comparisons on which it rested were of too sketchy and remote a character and the gaps bridged by hypothesis were too wide, and so morphology was led in many cases to wild and ridiculous conclusions. But the opinion of an expert in systematics is not to be dismissed as mere "verba". It is really a deduction from thousands of relevant facts which the critic has neither the time nor experience to be able to consider.

Prof. Haldane concludes with a disquisition on the subject of mutations, into which I will not follow him. As I said in my previous letter, it would have been an easy matter to have gone over the whole of his discourse and applied destructive criticism to every part of it, but I determined to confine myself to meeting his objections to the evidence adduced by me. But I shall conclude by placing on record my view of the nature of mutations and trusting to the future to vindicate it.

Johannsen, who invented the term 'gene', later publicly expressed his regret that he had ever done so, and defined mutations (or genes) as "superficial disturbances of the chromosomes". They have nothing to do with the characters of the natural races of animals (or plants). With this opinion I fully agree. Mutations begin differently and are inherited differently from true racial characters. This is the opinion of the best systematists whom I know, and surely in the long run the opinion of those who really understand what species, sub-species, and biological races are will ultimately prevail.

E. W. MACBRIDE.

43 Elm Park Gardens,
Chelsea, S.W.10,
July 2.

PROF. J. B. S. HALDANE, in his reply (NATURE, July 2) to Prof. E. W. MacBride's letter, once more returns to the subject of my experiments with the sawfly *Pontania salicis* and its transference from the foodplant *Salix Andersoniana* to *S. rubra*. As this portion of his letter is misleading, and might appear convincing to anyone not acquainted with the facts, it seems that a statement from me is necessary.

Actually, owing to Prof. Haldane's lack of knowledge of the geographical distribution of the two willows in question, not one of his remarks is relevant to the subject. It still remains a fact that *S. rubra* is a rare hybrid between *S. purpurea* and *S. viminalis*, and to challenge this on the ground that Druce records it from sixty-nine vice-counties shows a lack of appreciation of the basis of such a list, and of the numbers of individuals which represent such a hybrid in Nature. Moreover, the introduction of a reference to the value of *S. rubra* as an osier only makes matters worse; osiers are not cultivated here.

Again, when Prof. Haldane quotes Druce as recording *Salix Andersoniana* from thirty-four vice-counties, scientific accuracy should have caused him to state that these thirty-four (except for an outlier in Glamorgan) lie north of a line drawn across the country from N.E. Yorks to Lancashire. The probability of *S. Andersoniana* coming into contact with osier beds is thus very remote. Further, his statements imply that he does not realise that, in those northern and Scottish counties where both plants occur, the favoured habitats of *S. Andersoniana* differ widely from those of *S. viminalis*, *S. purpurea*, and, consequently, of their hybrid. In Durham, for example, *S. Andersoniana* is a plant which grows in profusion on the sea banks on the magnesian limestone and then jumps to subalpine areas well inland, whilst *S. viminalis*, *S. purpurea*, and *S. rubra* occupy the intervening zone. Very rarely indeed do *S. Andersoniana* and *S. rubra* overlap; in fact, in spite of very careful exploration to settle this very point, I cannot point to one locality which they possess in common!

Prof. Haldane ought to have realised that before I commenced the experiments I should take the elementary precautions of making sure (1) that the small patch of *S. rubra* selected for the work was free from *Pontania* galls, (2) that no other species of willows near carried the same species, and (3) that the colony of *S. Andersoniana* from which the transference was made was in a district remote from contact with *S. rubra*.

J. W. HESLOP HARRISON.

Armstrong College,
Newcastle-upon-Tyne,
July 4.

Filtration of Plant Viruses

THE preparation of graded collodion membranes has been greatly improved of recent years by W. J. Elford, who has developed a technique with which he can produce membranes of highly uniform structure and easily determinable average pore size. These he has used in an investigation of the probable sizes of bacteriophage and various animal viruses. We have examined a number of plant viruses with membranes prepared according to Elford's methods and with his generous help and advice; and a short statement of some of our experiences and results may be of interest in themselves and of value to others.

First as to the method of preparation of the membranes. In our hands it has not proved easy to obtain consistent results. The eventual pore size is dependent on the rate of evaporation from the surface of the liquid and is also enormously affected by the presence of traces of water; and very small local or general differences in atmospheric humidity, slight currents of air, and the like affect the final product to a surprising extent. There may be marked difference of pore size between the central area of a membrane and the portions lying nearer the rim. Such difficulties are not insuperable, but the most painstaking attention to detail is essential, and at present we find it advisable to standardise every membrane individually before use. Standardisation leaves room for some degree of latitude in the data, and, leaving aside theoretical considerations as to the applicability of the formula used to membranes of this structure, in our hands repeated standardisation of the same individual membrane has shown a progressive diminution in average pore size. These difficulties are gradually disappearing, but we mention them as a warning of the necessity of checking one's results with the greatest care.

The virus material we have used consists of juice extracted from diseased plants. This juice is very complex and may contain tannins, resins, and other readily precipitated materials which do not occur in animal tissues. As a consequence there is a rapid clogging of the pores, especially of the finer membranes, in spite of very thorough preliminary clarification by passage first through paper pulp and then through a coarse ($0{\cdot}6\mu$ or $0{\cdot}7\mu$) membrane. With some plants, for example, tomatoes, especially if more than a very few weeks old, this plugging is so thorough as to make the results quite useless as a guide to the size of the particles. With tobacco and certain other plants it is much less serious, but it is always present to some extent. To this is perhaps to be attributed the fact that we do not get a sharp endpoint. We do not find that the virus passes undiminished in quantity through the series of membranes down to a definite pore size, at which it no longer passes; there is a progressive reduction in amount all the way down. To take one example (where the quantity of virus

present was estimated by the number of spots developing on the leaves of *N. glutinosa*), after passage of paper pulp the number of spots was 407 per leaf; after $0{\cdot}8\mu$ membrane, the number was 220; after $0{\cdot}49\mu$, 38; after $0{\cdot}25\mu$ it was 6, and after $0{\cdot}1\mu$ or less, there were no spots. It may be necessary to remove this clogging material before passage of the membranes, and experiments are in progress for this purpose.

With all qualifications made, the results obtained are of interest and significance. As is the case with animal viruses, we find that the plant viruses differ greatly in size among themselves. The virus of tobacco mosaic (Johnson No. 1) passes the $0{\cdot}51\mu$ membrane, though in reduced quantity (only 4 plants infected out of 8), and passes the $0{\cdot}154\mu$ easily. The virus of yellow tobacco mosaic (Johnson No. 6) is of the same size, passing $0{\cdot}051\mu$ (2 plants positive of 8). Aucuba mosaic virus passes $0{\cdot}120\mu$ and $0{\cdot}112\mu$ but does not pass $0{\cdot}10\mu$, $0{\cdot}06\mu$, or $0{\cdot}051\mu$. The virus of a *Hyoscyamus* disease found by Dr. Marion Hamilton passes $0{\cdot}30\mu$ but not $0{\cdot}234\mu$ or any smaller membrane: and this is a point of some interest since (as she shows in a paper now in the press) this virus does not pass through a L.3. Pasteur-Chamberland porcelain candle, although its pore size is about $2{\cdot}5\mu$.

By Elford's method of calculation, these figures would indicate a particle size of $15\mu\mu$ for the tobacco and yellow mosaic viruses, about 40-$50\mu\mu$ for aucuba mosaic, and $150\mu\mu$ for the *Hyoscyamus* virus. The value found for tobacco mosaic comes midway between Duggar's estimate of 30-40mμ and the recent estimate of 5mμ by Waugh and Vinson.

It is possible by the use of these membranes to separate two viruses occurring together in nature in the same plant. Dr. Hamilton's *Hyoscyamus* virus was passed through a series of membranes. It passed $0{\cdot}64\mu$ and $0{\cdot}30\mu$ with characters unchanged; after passage through $0{\cdot}234\mu$, $0{\cdot}209\mu$, and $0{\cdot}120\mu$ the disease produced was of different type, and further investigation has shown that the virus passing the smaller membranes is entirely different in its properties from the other larger virus it accompanied, and it is possible to separate the two by other methods than filtration.

D. MACCLEMENT.
J. HENDERSON SMITH.
Rothamsted Experimental Station,
Harpenden, Herts.

Constitution of Tantalum and Niobium

THESE two elements of the vanadium group have properties very unfavourable to mass-spectrum analysis and all attempts previously reported have been completely unsuccessful. I have now been able to obtain their mass lines, owing to the kindness of Dr. P. Kronenberg of Berlin, who has prepared for me specimens of the pentafluorides. These solids are slightly volatile but their great chemical activity makes them troublesome to deal with. If, however, they are volatilised in the discharge tube itself, it is possible to obtain, at least intermittently, a discharge which contains the metallic ions. Under these conditions the data are not complete, but one result is beyond doubt, and this is, that notwithstanding their fractional chemical atomic weights, both elements are essentially simple.

Tantalum, which was investigated first, gave a strong line at 181 followed by a diminishing series 200, 219 . . . due to TaF, TaF_2 . . . Neither the expected isotope 183 nor any other could be detected even to one-fiftieth of the main line. The packing fraction of tantalum was estimated from the position of the line 200 among the mercury group to be -4. Owing to certain experimental difficulties, this is only to be regarded as a rough provisional value, but it eliminates any possibility of an abnormally high mass. Correcting to the chemical scale, this value gives

$$\text{Atomic weight of tantalum} = 180{\cdot}89 \pm 0{\cdot}07.$$

Niobium behaved in exactly the same way, giving a single line at 93 and fluorides at 102, 121 . . . It has not been possible to measure the packing fraction of niobium with accuracy, but direct comparison of the line 93 with line 85 (SiF_3) suggests a large negative value, about -8. This gives on the chemical scale

$$\text{Atomic weight of niobium} = 92{\cdot}90 \pm 0{\cdot}05.$$

The atomic weights of these elements given by chemical methods have always been regarded as unsatisfactory, and these results suggest that the present international values, 181·4 and 93·3, are considerably too high.

F. W. ASTON.
Cavendish Laboratory,
Cambridge, July 11.

Vibrations in Solid Rods

IN connexion with the study of vibrating metal rods, a method of investigation has been devised which promises to lead to a number of new and interesting results. The experiment consists in tapping a rod at one end with a small hammer, and then making visible the train of waves which occur as a result of the impact. This is accomplished in the following manner.

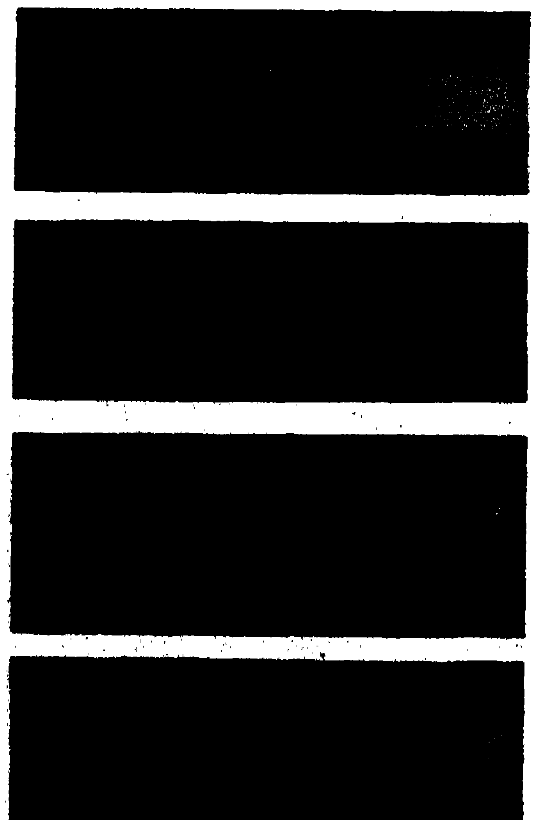

FIG. 1.

To the end of the rod opposite that which is tapped is cemented a piece of piezo-electric crystal, for example, quartz or tourmaline, which converts the vibrations at that point to an alternating voltage.

This voltage is amplified and impressed on a cathode ray oscillograph, which has in connexion with it a properly synchronised time-axis device. The hammer is driven by a synchronous motor and strikes the end of the rod ten times a second. By proper adjustment throughout, each train of waves occurs on the oscillograph screen exactly superposed on the preceding train, so that a steady picture is obtained representative of the periodic displacements of the end of the rod with time. This graph, as it really is, may be photographed if desired.

It has been found that in most cases the waves are quite complex, being combinations of longitudinal, flexural, and possibly other modes of vibration. In order to separate these component frequencies, the voltage from the amplifier may be passed through a tuned circuit and the selected frequency then impressed on the oscillograph. It is thus possible to pick out vibrations of different types.

In Fig. 1 are shown several examples of waves which occur in duralumin rods when they are struck with a hammer. The fourth curve shows the predominating frequency present in the wave immediately above it, this analysis being obtained with the use of the tuned circuit previously mentioned.

By measuring the decrement of any desired wave, the coefficient of solid viscosity corresponding to that frequency may be calculated, and it is believed that considerably greater accuracy may be obtained in this way than has been possible with previous, more indirect methods. From the fourth curve in Fig. 1, which corresponds to the fundamental mode of longitudinal vibration for a certain duralumin rod, the logarithmic decrement was found to be 0·016, giving a value for the coefficient of solid viscosity of $4 \cdot 6 \times 10^4$. Although this rod was of duralumin, it is interesting to note that in 1922 Dr. R. W. Boyle [1] suggested that when the coefficient was accurately determined for steel (in many respects similar to duralumin), its order would probably be not greater than 10^5. The variation of this coefficient with frequency and amplitude of vibration remains to be determined, but when this matter is examined in greater detail, it is probable that a clearer understanding of the nature of solid viscosity, including hysteresis, may be forthcoming.

GEORGE S. FIELD.

National Research Laboratories,
Ottawa, June 8.

[1] *Trans. Roy. Soc. Can.*, Sect. III., p. 293; 1932.

Mean Lives of the Lowest Metastable States in Neutral Oxygen, and Intensities of Lines Arising therefrom

Transitions from the lowest metastable levels in the OI spectrum are of interest as occurring in nebular and auroral spectra. The red lines $^3P_{2,1} - {}^1D_2$ (λλ6300, 6364), which have been produced in the laboratory by Hopfield,[1] have been identified by Paschen [2] as occurring in the spectra of some of the nebulæ, and by Sommer [3] as occurring in the spectrum of the night sky, while the line $^1D_2 - {}^1S_0$ (λ5577) is the well-known auroral green line first identified by McLennan. A theoretical calculation of the intensities of such transitions and the mean lives of the metastable states is therefore of interest.

These 'forbidden' transitions are evidently due to quadripole radiation, for the Zeeman effect in the auroral green line has been shown by Frerichs and Campbell [4] to be in agreement with the supposition of quadripole radiation, but inconsistent with the hypothesis of perturbed dipole radiation. In a forthcoming paper in the *Proceedings of the Royal Society*, I have made the corresponding calculations for OIII with reference to nebular lines, on the assumption of quadripole radiation.[5] The final results are expressed in terms of integrals of radial wave functions, thus depending only on the central field of force adopted, and these integrals can be calculated from a comparison of calculated and observed separations between the levels. Now, Heisenberg [6] has shown recently that the wave equation for the lowest levels of an atom in which there are n electrons outside closed shells only differs, in first approximation, from that of an atom in which there are n 'holes' (that is, a closed shell is incomplete by n electrons) in that a different central field of force must be adopted. This enables the method outlined above for OIII to be applied immediately to the case in hand, thus yielding the following results for the $2p^4$ terms in OI:

Line.	Relative Intensity (per atom).
$^3P_2 - {}^1D_2$ (λ6300)	3
$^3P_1 - {}^1D_2$ (λ6364)	1
$^3P_0 - {}^1D_2$ (λ6391)	4×10^{-4}
$^1D_2 - {}^1S_0$ (λ5577)	1
$^3P_2 - {}^1S_0$ (not observed)	10^{-7}
$^3P_1 - {}^1S_0$,,	2×10^{-3}
$^3P_0 - {}^1S_0$,,	0

Relative intensity of $^1D_2 - {}^1S_0$ to $^3P_2 - {}^1D_2 = 1400 : 1$
Mean life of $^1S_0$ state = 0·02 sec.
,, ,, $^1D_2$,, = 100 sec.

The results are, of course, only approximate, the figures for $^1D_2 - {}^1S_0$ and the mean life of the $^1S_0$ state being less accurate than the others. The only direct comparison with observation is in the relative intensity of lines with $^1D_2$ as initial state. The relative intensity of $^3P_{2,1} - {}^1D_2$ is about 4 : 1 according to Hopfield,[1] while for the nebula N.G.C. 7027 the ratio is about 5 : 2 according to Wright.[2] The line $^3P_0 - {}^1D_2$ (λ6391) is not observed in the nebulæ, but was weakly observed in the laboratory according to Paschen.[2] These results are in satisfactory agreement with the above. In a subsequent paper, however, Paschen [7] gives the relative intensity of $^3P_{2,1,0} - {}^1D_2$ as 5 : 3 : 1. If this were really the case, it would, of course, be in serious disagreement with the theory.

The figures for the mean lives throw some light on conditions in the nebulæ and the auroral regions. If it becomes definitely established that the red lines (λλ6300, 6364) occur in the auroral spectrum, the observed relative intensity of λ5577 to λ6300, combined with the above calculated relative intensity *per atom*, would furnish the relative number of atoms in the $^1S_0$ and $^1D_2$ states, which would be of interest in connexion with possible processes of excitation in the upper atmosphere.

I wish to thank Mr. M. F. Crawford for valuable discussion of the experimental data.

A. F. STEVENSON.

Department of Applied Mathematics,
University of Toronto,
May 26.

[1] Hopfield, *Phys. Rev.*, 37, 160; 1931.
[2] Paschen, *Naturwiss.*, 18, 752; 1930.
[3] Sommer, *ibid.* Cf. Grotrian, *Naturwiss.*, 20, 85; 1932.
[4] Frerichs and Campbell, *Phys. Rev.*, 36, 1460; 1931.
[5] Cf. also Bartlett, *Phys. Rev.*, 34, 1247; 1929.
[6] Heisenberg, *Ann. Phys.*, 10, 888; 1931.
[7] Paschen, *Z. Physik*, 65, 1; 1930.

Layer-chain Structures of Thallium Di-Alkyl Halides

DURING the last year we have been studying the crystal structures of a series of compounds R_2TlX, which prove to be of some interest in view of the recent work on the rotation of molecules in crystals. The dimethyl thallium halides are tetragonal and the others orthorhombic, pseudo-tetragonal, and all show

a sodium chloride-like structure. Layers of TlX parallel to the *ab* plane are spaced out at distances depending on the length of the alkyl chains, which are attached to the thallium ions perpendicularly to these layers. The *a* and *b* cell dimensions are almost independent of the alkyl group and vary between 4·29 A. (chloride) and 4·76 A. (iodide). These spacings, which, except in the case of the iodide, are much lower than the values 4·85 A. (Müller) [1] and 4·76 A. (Bernal) [2] found for the distance between rotating chains, are in agreement with other indications that the chains in these compounds do not rotate.

There is evidence that the chains are not of the usual zigzag pattern, but are like Müller and Shearer's [3] suggested type 3, and the two covalencies of the central thallium atom in the chain are at 180°.

We have also studied the double refraction of these compounds, which combine the characteristics of both chain and layer structures. The following table shows that the sign of the double refraction may be either positive or negative according as the influence of the chain or layer character is the greater (cf. Bernal's observation, loc. cit., of negative double refraction in an alkyl ammonium chloride).

Sign of Double Refraction

X	$TlMe_2X$	$TlEt_2X$	$TlPr_2X$
I	–	–	–
Br	–	+	–
Cl	+	+	+

The variations can be satisfactorily explained by a simple extension of the method of Wooster,[4] by taking into account the relative importance of the various atoms in their contribution to the refraction.

A detailed account is in preparation.

H. M. Powell.
D. M. Crowfoot.

Department of Mineralogy,
University Museum,
Oxford.

[1] Nature, 129, 436, March 19, 1932.
[2] Nature, 129, 870, June 11, 1932.
[3] *J.C.S.*, 123, 3156; 1923.
[4] *Z. Krist.*, 80, 495; 1931.

A Metagalactic Cloud between Perseus and Pegasus

During the course of an investigation concerning the occurrence of bright metagalactic clusters, I have found between the constellations Perseus and Pegasus a number of clusters of anagalactic nebulæ which seem to form subsystems of an extended metagalactic cloud. This cosmical unit can be traced in Herschel's G.C. and is very conspicuous in the N.G.C. and I.C. material. On the whole, the supersystem is composed of fifteen or nineteen larger and smaller metagalactic clusters, situated between $\alpha = 23^h$, $\delta = +20°$ and $\alpha = 3^h\ 20^m$, $\delta = +48°$. All the subsystems are arranged in a zone reminding one of a region of the galaxy. The well-known Perseus cluster, discovered by M. Wolf, is involved on the north-following boundary, and the Pisces group (E. P. Hubble) near the central region of the cloud. A connexion between the metagalactic cloud in question and the Pegasus cluster is suggested.

450 N.G.C. objects are situated in the general field of the cloud, and the main bulk of these objects seem to be physical members of the cloud. The density of nebulæ in this part of the sky is remarkable. Thus we count 117 N.G.C. objects in the central region, but only 8 and 3 respectively in equal large areas, situated north and south of the said region. Translating the literal symbols of magnitudes given in N.G.C. into numerical values of total magnitudes, we obtain for 312 nebulæ, obviously belonging to the cloud, a frequency-curve of total magnitudes remarkably similar to the corresponding curve for the objects in the bright Virgo cloud, discovered and studied by H. Shapley. Thus the curve also shows the 'hump' in its ascending branch, earlier found by W. Baade in the case of the Ursa Major cluster.

The distance of the bright metagalactic supercluster (or cloud of galaxies) can be assigned the preliminary value of 10×10^6 light-years, the extension and depth of the cloud to about 30×10^6 light-years in accordance with the distances found for the known clusters of faint nebulæ involved in the metagalactic cloud here considered.

W. E. Bernheimer.

Observatory, Lund,
April 25.

Energy of Dissociation of Nitrogen

In Nature of June 11, page 870, A. K. Datta gives the energy of dissociation of nitrogen as deduced from his measurements of the absorption spectrum of nitrous oxide.

The value − 18·1 appears to have been used for the heat of formation of the latter gas. This value is so suspect that a redetermination has been made in this department,[1] and similar work is in progress at the National Physical Laboratory.[2] Using the value[1] − 20·6, Datta's figure becomes $9{\cdot}0_0$ volts or 208 kilocalories.

The following table includes the more recent values obtained by various methods, and shows that the energy of dissociation of nitrogen is now comparatively well known:

Birge . . .	9·04 ± 0·2 volts	Nature, 122, 842; 1928 *T. Faraday Soc.*, 25, 713; 1929
Kaplan . .	9·0 volts	*Proc. Nat. Acad.*, 15, 226; 1929
Tate and Lozier	8·4 ± 0·5 volts	*Phys. Rev.*, 39, 224; 1932
Datta (corrected)	9·0 volts	Nature, 129, 870; 1932

T. C. Sutton.

Research Department,
Woolwich,
June 12.

[1] T. C. Sutton, *Phil. Mag.*, 1932 (in press).
[2] Annual Reports, 1931, 13 and 75.

Fatuoids or False Wild Oats

Mr. E. T. Jones's observations [1] are, as he remarks, highly important in their bearing on the problem of the origin of fatuoids or false wild oats. The conclusions to be drawn from these observations are, however, in my opinion, precisely opposite to those drawn by Mr. Jones. His data, showing that two or more genes are concerned in the production of the fatuoid complex in diploid × tetraploid oat hybrids surely support my assumption that the fatuoid complex of hexaploids is determined by a number of linked genes. Therefore, for fatuoids to arise by gene mutation, as he considers they do, it is necessary to assume mutation occurring simultaneously in all these genes—a rather improbable assumption. The change in dominance, stressed by Mr. Jones, has in other cases been shown to be directly attributable to polyploidy.

As for the absence of crossing-over in fatuoids, this is a characteristic of chromosome aberrations in

general, now very widely established. I must confess inability to see how it can support the gene mutation theory of the origin of fatuoids, but on the chromosome aberration theory it is expected, since chromosomes *B* and *C* are not complete homologues. They are considered to be homologous along parts of their length, but not in the region bearing the fatuoid genes. Hence, complete linkage or absence of crossing-over is expected *in this region*.

In a paper [2] on the analogous speltoid mutations of wheat, I stated that the formulæ for fatuoids and speltoids there presented, and quoted now by Mr. Jones, were provisional and would probably have to be modified. Five years' further cyto-genetic work, with greatly improved cytological technique, has demonstrated the need for modification, but not for any fundamental changes in the original hypotheses and formulæ. Instead of duplication of whole chromosomes, it is now clear that only parts of chromosomes are duplicated in some mutant strains. The hypothesis that fatuoids arise through chromosome aberrations is, I consider, now so well established for most strains I have studied (including strains of Series *A*) that it appears to me unnecessary at present to resort to the alternative gene mutation hypothesis for those cases in which the evidence of aberration is not yet so clear.

It is, however, impossible here to summarise adequately the voluminous data upon which this opinion is based. They will be assembled for publication after the present season's work is completed. The object of the present note is to answer Mr. Jones's criticisms by indicating the very different interpretation which it is possible to place upon his observations. The observations themselves are certainly very important, for their bearing not only on this problem but also on the wider problem of the origin of cultivated oats.

C. LEONARD HUSKINS.

McGill University,
Montreal.

[1] NATURE, 129, 617, April 23, 1932.
[2] *J. Genetics*, 20; 1928.

IN a letter recently contributed to these columns,[1] Mr. J. Philp makes certain statements and arrives at certain conclusions in respect of the subject-matter of a communication made by me to this journal [2] which require consideration.

In reading through Mr. Philp's letter it appears to me that he has not clearly apprehended the facts stated in my communication. From my *descriptive* statement that "Segregates have appeared in this cross [*A. barbata* × *A. brevis*] in which the basal articulation and basal pubescence characters of the *A. barbata* parent occur in association with the awn and grain-apex of *A. brevis* type . . ." he concludes that I maintain that grain-apex, as well as awn, is linked with the fatuoid complex, although in an earlier part of the same paragraph I definitely refer to the fatuoid complex as consisting of the characters *articulation, basal pubescence*, and *awn*. I have expressed no view as to whether the grain-apex is or is not linked with the fatuoid complex. The cross-over types in question, so far as the fatuoid problem is concerned, relate to the appearance of a weak awn (of *A. brevis* type) in association with a horse-shoe shaped base and dense basal pubescence (a combination of characters not hitherto recorded); and conversely, the twisted geniculate awn (of *A. barbata* type) in association with a 'cultivated' type of base.

The other misapprehension, and a very fundamental one, relates to a statement (a presumption on Mr. Philp's part) that my observations are based upon a triploid hybrid. In the second paragraph of my communication it is clearly indicated that the cross-over types under consideration are F_3 segregates possessing the diploid chromosome number.

As Mr. Philp's letter is based almost entirely upon these two main issues, his criticisms and conclusions require no further comment.

Prof. C. L. Huskins puts forward the view that it is possible to explain the observed cross-over types as evidence in support of the chromosome aberration hypothesis.

The cross-over types in question exhibit a breakup of the fatuoid complex into two parts. We have, therefore, on the basis of the present evidence, to examine the case for the probability or improbability of simultaneous mutations occurring in these two 'units'. On the basis of the modified gene-mutation hypothesis, the mutations are considered to occur not in the *B* chromosome but in *C*. This is a point of importance when making comparisons of the expectations of crossing-over, or of gene mutations, in Series-*A* hexaploid fatuoids with the 'diploid' cross-over types of the diploid-tetraploid cross. In the latter, the cross-over affects both the *B* and *C* chromosomes. The necessity for assuming that the occurrence of simultaneous mutation in both 'units' of the gene complex in Series-*A* fatuoids depends, therefore, upon whether the linkage in the corresponding epistatic genes in the *C* chromosome is of the same degree as that between the genes of the *B* chromosome, which are fundamental in the determination of the fatuoid characteristics; and whether the epistatic genes in *C* are numerically similar to those in *B*. There is evidence, however, that all mutations occurring in *C* are not of the same degree of complexity, and as examples of the divergent mutant types thus produced, I may mention the already recorded strongly awned Types *A*, *B*, and *C*, and the fatuoid of Golden Rain.[3] From these observations it may be inferred that simultaneous mutation does take place, but not always in the same degree. On its extent, therefore, depends the appearance of fatuoids, sub-fatuoids, semi-fatuoids, or simply strongly awned types, and their relative frequency must depend upon the extent to which one gene or set of genes mutates in relation to the others. Probability, therefore, is not so very remote.

With regard to the homology and genic identity of the *B* and *C* chromosomes, that is, assuming for the moment that we are dealing with a case of whole chromosome aberration as originally postulated by Prof. Huskins, I know of no positive evidence which proves that the *B* and *C* chromosomes carry identical genes throughout the whole of their length, excepting, of course, those which determine the fatuoid complex. There is, however, on the contrary, evidence to show that in some oat varieties genes affecting spikelet number are present and also genes affecting the morphological character of the awn.[3] As Prof. Huskins has himself put forward the view that the *B* and *C* chromosomes have had a separate specific origin, their identity in gene constitution is on this account scarcely to be expected. On the basis of the chromosome aberration formulæ, it has to be assumed that the *B* and *C* chromosomes are identical and interchangeable without any apparent phenotypical changes other than those appertaining to the fatuoid complex. If, however, Prof. Huskins wishes to maintain, as now appears to be the case, that in most strains what we have is not whole chromosome aberration but a duplication of only parts of the chromosome, then surely some fundamental modification of the formulæ is necessary. This, in his letter, he does not permit. As, however, the critical details of the application of this modified interpretation of the chromosome aberration hypothesis have not yet been

published, to comment upon this aspect of the problem would be purely hypothetical.

Genetical data showing the inadequacy of the chromosome aberration hypothesis to explain Series-*A* fatuoid phenomena have already been published.[3] Recently, on the basis of cytological investigations of material supplied by Prof. Huskins, Nishiyama [4] has corroborated my conclusions in respect of Series-*A* fatuoids, namely, that they arise by mutations occurring in the *C* chromosome.

The validity of the chromosome aberration hypothesis as such does not necessarily arise in these discussions; the point at issue is its applicability as an explanation of the origin and behaviour of Series-*A* fatuoids, sub-fatuoids, and semi-fatuoid types which show regular and simple Mendelian segregation and possess normal ($2n = 42$) chromosome numbers.

A theoretical case for opposite conclusions can very probably be made out, based upon the assumption of some form of chromosome duplication, but until the occurrence of the latter is substantiated, there are no convincing reasons why we should depart from the principle of complex gene mutation as first postulated by Nilsson-Ehle.[5]

E. T. JONES.

Welsh Plant Breeding Station,
University College of Wales,
Aberystwyth, June 24.

¹ Philp, J., NATURE, **129**, 796, May 28, 1932.
² Jones, E. T., NATURE, **129**, 617, April 23, 1932.
³ Jones, E. T., *J. Genetics*, **23**; 1930.
⁴ Nishiyama, I., *Japanese J. Genetics*, **7**; 1931.
⁵ Nilsson-Ehle, H., *Hereditas*, **11**, 401; 1921.

Inheritance of Fluorescence in Rye-Grass

I AM engaged on the cytology and genetics of perennial rye-grass (*Lolium perenne* L.) and Italian rye-grass (*L. multiflorum* Lam.). It is commonly believed that many plants intermediate between these two species are a result of hybridisation, and it was the object of the work to investigate this hybridism. In the course of the investigations, the inheritance of fluorescence of roots under ultra-violet light[1] has been studied. The fluorescent character which is found in Italian rye-grass and strains of 'false' perennial but not in true perennial rye-grass offered an opportunity for rapid classification of types.

Twenty-eight parent plants were tested for fluorescence after allowing tillers to grow roots on filter paper. Sixteen of these were 'non-fluorescent' and twelve were 'fluorescent'. These plants were self-pollinated by using cellophane bags, and the work was carried out under controlled conditions in the glasshouse. The seedlings resulting from the self-pollination were examined for fluorescence. Of 1459 seedlings tested from the 'non-fluorescent' plants, all except one (probably a contamination) were 'non-fluorescent'. Nine of the 'fluorescent' plants gave 100 per cent 'fluorescent' seedlings, the total number tested from these plants being 885. The remaining three 'fluorescent' plants produced both 'fluorescent' and 'non-fluorescent' seedlings. One of these gave 191 'fluorescent' and 65 'non-fluorescent' (a ratio of 2·94 : 1), another 126 and 40 (a ratio of 3·15 : 1), and a third 8 'fluorescent' and one 'non-fluorescent'. Insufficient seeds to give a significant result were obtained from this plant. The first two results, however, appear to indicate that fluorescence depends on a single Mendelian factor, and that the two parent plants are heterozygous for this factor.

The relationship between fluorescence and some botanical characters of the plants is of interest. The flowering glumes of the 'non-fluorescent' plants were awnless and the leaves conduplicate in the bud. The flowering glumes of the plants which produced 100 per cent 'fluorescent' seedlings were awned and the leaves convolute in the bud, although, as is usual in *L. multiflorum*, the basal flowering glumes of the lower spikelets were often awnless. The three parent plants which produced both 'fluorescent' and 'non-fluorescent' seedlings differed from one another in awn characters. One was awnless, in the second there were a few flowering glumes with very short awns, while in the third some of the flowering glumes produced either short or well-developed awns. They were similar, however, in that in each case the leaves in the bud were conduplicate.

This work is being continued.

L. CORKILL
(Macmillan Brown Agriculture Research Scholar).

Botanical Department,
Massey Agricultural College,
Palmerston North,
New Zealand,
May 16.

¹ Gentner, "Prak. Bla. f. Pflanzenbau und Pflanzenschutz", 1929; Linehan and Mercer, *Sci. Proc. Roy. Dublin Soc.*, 1931; Foy, *N.Z.J. Agr.*, 1931.

A New Method for Mitochondria

I HAVE recently found that quinone (parabenzoquinone) has an intense fixative action upon mitochondria. It is best to treat tissues for an hour with quinone dissolved in saline first, and then to transfer them to any fixative one may choose. I have found this much preferable to using quinone-saline alone or mixing it with any other fixative. The quinone may be at any concentration from 0·05 per cent for delicate tissues (such as kidney) to 0·5 per cent for liver. Plenty of fluid should be used. The saline should be roughly isotonic with the blood of the animal used, but if the quinone is used at 0·5 per cent, it is as well to make the saline 0·1 per cent less concentrated than usual, so as to avoid having the fluid hypertonic. Surprisingly enough, Carnoy's fluid is one of the best fixatives to use after quinone. I have used the formula without chloroform.

It is remarkable that one hour's treatment with such a weak solution as 0·05 per cent of quinone should render the mitochondria insoluble in the fixative which is regarded as the most destructive of them. Bouin's fluid is also excellent after quinone-saline. One may stain with iron hæmatoxylin, or by Altmann's or Benda's method. In using Altmann's method, a convenient differentiator is one part of absolute alcohol saturated with picric acid to seven parts of 30 per cent alcohol, used cold. If one uses Carnoy's fluid and follows with Altmann's method, one may fix one's tissue in the morning and have finished slides of mitochondria in the evening. No special mordantage is required for subsequent staining in Benda's alizarin and crystal violet, which gives good results after Carnoy's fluid.

The technique has been worked out mostly with the liver of the newt and the liver and kidney of the guinea-pig. No advantage has been found in substituting other quinones for parabenzoquinone.

Full details of the technique, with an account of the research leading up to it, will be published in the *Quarterly Journal of Microscopical Science*.

I wish to thank Prof. E. S. Goodrich and Dr. H. M. Carleton for helpful criticism of my slides, and Mr. C. E. J. Crawford for chemical advice.

JOHN R. BAKER.

Department of Zoology and Comparative Anatomy,
University Museum, Oxford, May 30.

Research Items

Indian Village Godlings.—In an account of the cult of Bāro Bhāiyā, a form of 'demon worship' prevalent in Eastern Bengal (*J. and Proc. Asiatic Society of Bengal*, N.S., vol. 26, No. 1), Mr. Chintaharan Chakravarti points out that no trace of the religious rites of the village folk of India, often very interesting, is found in any scriptural text, though the people retain palpable traces of undoubtedly ancient rites. In the cult of Bāro Bhāiyā, or the Twelve Brothers, as observed in Kotālīpādā in the district of Faridpur, the objects of worship are twelve brothers and their sister or mother. It is known also popularly as the cult of Vanadurgā (the mother of the twelve brothers) or Niśānātha. The brothers are described as demons and terrible in appearance. Any displeasure on their part brings disease and calamity. Vanadurgā has been described as a tree goddess, as her worship takes place under a tree and she has no separate image. There is no fixed time for the worship of these deities; but it usually takes place on Tuesdays and Saturdays and in the day-time. Generally no images are made; but there is an effigy of one of the brothers in a house in the village of Unaśiā. At Kotālīpādā the worship is performed at the base of a big Aśvattha tree, the place being known as Niśāi-kholā, or the place of worship of Niśāi. There is no provision for daily worship as in the temples. The rites of worship follow those laid down in the scriptures with regard to worship in general, except that the heads of the sacrificed animals are not taken back, but are left in the hollow of a tree. The mantras used are all in Sanskrit, and the whole worship has been made to conform to the Tantra form, the deities being given Sivaite implements and attributes, showing how a purely popular cult has been affiliated to Aryandom.

Fortifications at Tell el-Ajjūl.—Lieut.-Col. N. P. Clarke offers a reconstruction of the defences of Tell el-Ajjūl, Southern Palestine, so far as revealed by excavation to date, in *Ancient Egypt*, pt. 1, 1932. On the south-west side the tell is protected by the Wady Ghazzeh; on the remaining three sides by the Great Fosse, from which the earth was thrown out on the hill to form a slope of 35°; while the slope of the counterscarp is 1 in 4. The dominance of the site over the neighbourhood and its strength were due entirely to artificial works. On the north-east the ground was undulating and probably afforded cover to an attacking enemy. As might be expected, there appears to have been a work in this direction to deny this ground to an enemy. A pit has been discovered, the earth from which, contrary to normal practice, has been thrown *outwards* to form a bank. This was a self-contained outpost, the great depth of which gave perfect cover from archery. A tunnel leads from near the main entrance on the north-east side to the work, which holds, possibly, one hundred men. A sunken road also leads from the tell to the pit. A similar pit, which was probably also connected with the tell by a tunnel, lies several hundred yards to the north. These belong to the earliest system of defence, and there is evidence to suggest that they are of the copper age (3500–3000 B.C.) or shortly after. The northern trenched enclosure includes the pit outpost and must be later. A different system of trenches runs off the north-east corner; but instead of the irregular lines of the pits, the trenches run in long straight lines. They strengthen the entrance of the tell itself by outflanking any attack on the gates.

The Trunk of a Mammoth.—Some eight years ago a Tungus hunter found a well-preserved mammoth's trunk in the Bolshaya Baraniha River in Siberia, the first proboscis-tip to have been seen since the days of the palæolithic age (Science Service, Washington, D.C.). After various wanderings, the proboscis-tip reached the Museum in Leningrad, and it has now been described by Dr. G. Flerof. In general, there is a resemblance to the trunk-tip of the Indian elephant, but the 'lip' is much longer and wider than that of any modern elephant and gives the entire tip a bilobed appearance. Its adaptation is towards the efficient plucking of large bunches of grass or moss, at which it would be more adept than Indian or African elephants, which feed largely upon the leaves of trees and shrubs. An interesting point, the report states, is that European cave drawings sometimes represent the mammoth as having a bilobed trunk-tip, and the recent discovery of the frozen specimen shows again how keen was the perception of the artists of the old stone age, and how accurate were their drawings.

Bibliography of the Sardines.—The sardine is of enormous commercial importance in both Europe and America. But throughout their entire existence the sardine fishing, curing, and canning industries have always suffered from disconcerting fluctuations in the stocks of the various sardine species. On both sides of the Atlantic much research has therefore been undertaken in an as yet more or less unsuccessful attempt to elucidate the life histories of these fishes and to understand the causes underlying their erratic habits. A vast and scattered literature has therefore grown up around them. In order to facilitate reference to all the published works on *Sardina pilchardus* (Europe), *S. melanosticta* (Japan), *S. ocellata* (South Africa), *S. sajax* (west coast of South America), and *S. caerulea* (west coast of North America), a bibliography has been compiled and is now published as *Fish Bulletin* No. 36 of the Bureau of Commercial Fisheries, California. With few exceptions, the compiler, or her associates, has consulted every paper or publication listed, and a brief summary of the contents of each is appended immediately following the title. The usual system of listing the authors alphabetically and the papers of each author chronologically has been adopted. This carefully compiled and very full bibliography should prove of immense benefit to all students of the sardine in the spheres of both natural history and of commerce. Copies are offered free of charge to interested persons and in exchange for the publications of other bodies engaged in marine research. Address: California State Fisheries Laboratory, Terminal Island, California.

Indian Fungi.—Dr. E. J. Butler and Dr. G. R. Bisby have recently published a book which attempts to collect together our knowledge of the fungi of India (The Imperial Council for Agricultural Research, Scientific Monograph No. 1: "The Fungi of India". Government of India Central Publication Branch, Calcutta, 1931, pp. 237, 11*s*.). The authors have consulted more than five hundred scientific papers, and have compiled a descriptive list which should help the student of mycology in the large area under review. The introduction is perhaps the most interesting part for the general student. Comparisons of the fungus floras of India and Europe are made, and show that more than twenty-three per cent of the total number of species are also represented in Europe. This is more than the proportion of phanerogams, for only six per cent of the number of species of flowering

plants occur also in Europe. There are other interesting comparisons of distribution which should interest the ecologist as well as the student of mycology. An extensive list of synonyms is given and will go far towards clearing up many difficulties of nomenclature.

Twisted Trees.—Recent observations of trees the trunks of which have a clockwise or counter-clockwise twist appear to show that this is not produced either by the wind or by any reaction to the movement of the sun. Mr. F. Knorr (*J. Heredity*, vol. 23, No. 2) has made a number of further observations on conifers in California. In 1926, search disclosed 486 twisted trees, in 44 per cent of which the twist was clockwise, 56 per cent the reverse. The following year, with still larger numbers belonging to six species, 27 per cent of the trees were found to be twisted, 52 per cent of them clockwise. In later years it was found that only part of the species in a particular area would show twisting. In the giant redwood and in certain deciduous trees, secondary growths showed the same twist as the parent trees. Examination of conifer seedlings showed that the twisting begins with the woody thickening both in stem and root, while in older trees the branches and twigs show the same twist as the main trunk, although the intensity of twist may vary to some extent. These observations all suggest that twisting of the wood may be a genetic character, and if this is the case, the habit of western lumbermen in leaving twisted trees for seeding purposes because they are of less economic value will be very unfortunate in its effects.

Microscopic Determination of Ore Minerals.—The optical and microchemical study of opaque minerals is now reaching a mature stage in its development. The most recent work on the subject in English (*U.S. Geol. Surv., Bull.* 825, 1931, pp. 204) has been written by M. N. Short, who has himself been occupied with the investigation of improved methods during the last four years. From a research point of view, the book is noteworthy because, for the first time, full determinative tables are given incorporating the effects of polarised light on polished surfaces of ore minerals. A far-reaching and critical study of qualitative microchemical tests for elements forms the basis of another and equally useful set of determinative tables. A combination of these two methods with the etching processes devised by Davy and Farnham, Murdoch, and others brings the whole technique up to the level of reliability attained by the better known petrographic methods involving the use of transmitted light. The work concludes with a list of specific tests for minerals, the latter being arranged alphabetically. It is obtainable from the Superintendent of Documents, Washington, D.C., at a cost of 60 cents.

Boring for Oil in Egypt.—The third section of the Report on "Boring for Oil in Egypt" (Cairo: Government Press, 1931) deals with the eastern desert and adjoining islands. Mr. T. Sutton Bowman gives a full and detailed account of his investigations of the samples from various wells drilled in this territory, and the report is of note as being one of the few lengthy expositions on the use of sedimentary petrography ('heavy' minerals, etc.) in oilfield (subsurface) problems, published outside America. The specialist in this subject will profit by reading Mr. Bowman's account of his methods and findings, and while some of the former are open to criticism, there is little doubt that this region has provided yet another case of the value of intensive petrological work in competent hands. The stratigrapher will find that the problem of the Nubian Sandstone has been re-attacked, and, although admittedly the evidence is at present of local significance and based on work which is incomplete, the sharp petrographic distinction established between the Cenomanian on one hand, and the Turonian and Santonian and true Nubian Sandstone on the other, is indicative of at least a promising means of analysing this composite lithology in other regions of Egypt.

Greenland Weather.—The weather of Greenland has importance in the institution of a great circle flying route between Great Britain and North America, and was investigated by the recent British Arctic Air-Route Expedition. Some results are given in a paper by Mr. S. T. A. Mirrlees in the *Geographical Journal* for July. During summer, visibility on the east coast was good when once the low fog belt over the pack ice was left behind, and during winter, apart from the short hours of daylight, it was fairly good. Winds on the east coast were light in summer, but gales were very frequent in winter and of great violence. They were, however, local and might possibly be avoided if choice of landing places were available. The observations from the ice cap station are, however, the most important and cover a period of about eight months. Poor visibility showed a frequency of 44 per cent, but probably drifting snow accounted for fully half of these occasions, and since the drift layer is shallow, it would not affect aviation. Strong northerly winds were frequent and calms rare, but gales were less common than on the coast. The average temperature of the air on the ice cap varied from 2° F. in September to - 33° in February, and the variation of temperature was great from day to day and depended on the direction and force of the wind. Inversion of temperature at heights of 1000-1500 ft. was found to be common, and the lowest temperature recorded at those heights was - 14° F., but there are no records for June, July, October, and November. Cloudiness at the ice cap station was small. Flight-Lieut. D'Aeth concludes that a summer flying route over Greenland would be entirely practicable, but that winter flying would be difficult and necessitate an efficient ground organisation.

Structure of Atomic Nuclei.—Now that neutrons have been detected as probable products of the artificial disintegration of light elements, it will be necessary to accommodate them in some way in the scheme of nuclear structures. An attempt at this has been made by F. Perrin (*J. Physique*, May, p. 96, S.). In his first scheme, the particles employed for the light elements are helium nuclei (α), neutrons (ω) and protons (π). The scheme explains nicely the strong emission of neutrons, without protons, in the artificial disintegration of beryllium, the structure of which becomes $2\alpha\ 1\omega$, and is otherwise fairly satisfactory, except in the case of nitrogen, which, written as $3\alpha\ 1\omega\ 1\pi$, should apparently be capable of giving neutrons as well as protons, whereas the former are not emitted. Largely on this account, a second scheme, which is highly suggestive, has also been proposed, in which the protons are supposed linked up with neutrons to give 'demihelions' (η), particles of mass 2 and unit charge, which are in fact known now through the discovery of the heavy 'hydrogen' isotope spectroscopically. On this scheme beryllium remains the same as before, but nitrogen becomes $3\alpha\ 1\eta$. The important implication of this second scheme is that the particles produced in artificial disintegration which have been generally supposed to be protons may actually be demihelions. The experimental evidence already extant should be adequate to decide this point, but it is noted that it could at least account for certain features of Blackett's photographs of the artificial disintegration of nitrogen. Perrin also gives

schemes for the nuclear structure of the elements from neon to potassium, analogous to his second scheme for the lighter elements, but with the modification that the maximum number of α-particles which could occur on purely numerical grounds is not employed, to obtain agreement with the results of disintegration experiments. It is interesting to note that there is some indication from this of why potassium (41) should have a natural radioactivity.

The Bleaching of Cellulose Materials.—In 1927, Clibbens and Ridge, of the Shirley Institute, carried out some important work on the action of chlorous bleach liquors on cotton, and revealed the surprising fact that in such cases the degradation of the cellulose was most rapid at a *p*H value of about 7, that is, at the neutral point. Subsequent work by Kauffmann, Weiss, and others, along different lines, has led to the same conclusions, although none of the theories advanced in explanation is entirely satisfactory, since they ignore the effects of variations in the concentration of cellulose. The problem has now been attacked from the point of view of the bleaching of wood cellulose by F. H. Yorston, of the Canadian Forest Products Laboratory (*Proc. of the Canadian Pulp and Paper Assoc.*, p. 31; 1932), who has found that an experimental bleaching mixture may be buffered to a *p*H value of 8·8-9·2 by addition of light magnesia, increase in acidity by neutralisation of the free lime by carbon dioxide being thereby avoided. In addition, it was possible to follow the rate of reduction, at *p*H 9, of hypochlorite by pulps which had already consumed various amounts of bleach, and to show that this reaction is monomolecular with respect to hypochlorite. It is concluded that the proportion of those substances present in the pulp in relatively high concentrations (for example, celluloses and pentosans) is probably little changed by the action of the hypochlorite, especially if allowances are made for the effect of the oxidation of soluble lignins on the apparent rate of reduction of hypochlorite and for the autodecomposition of the hypochlorite itself. An additional observation of interest is the superior colour of pulps bleached in an alkaline medium.

Astronomical Topics

Comets.—It is now established that there was a nebulous object near Newman's comet on the evenings of June 25 and 29. *U.A.I.Circ.* 392 contains a letter from Dr. Schmitt stating that he observed the object visually on June 29 with the Algiers equatorial, and also found it on his plates; he then examined the two exposures made on June 25, and found two images that indicated nearly the same motion as that of Newman's comet, which was registered on the same plate. On the first four days of July, observers at Bergedorf, Neubabelsberg, Heidelberg, Norwood, Yerkes failed to find any companions to Newman's comet, but on July 6 and 7, M. Delporte photographed two companion bodies at Uccle. Computations by Dr. M. Davidson make it unlikely that either of these is identical with the object of June 25 and 29.

A plausible conjecture is that Newman's comet has been expelling a series of vaporous masses, which have remained visible for a few days and then dissipated. The following table gives the distances of the three objects from Newman's comet:—First Object, June 25, E.100·43^{sec}, N.11′ 44·8″; June 29, E.114·42^{sec}, N.7′ 29·9″: Second Object, July 6, E.49·17^{sec}, S.3′ 34·9″; July 7, E.47·09^{sec}, S.1′ 45·4″: Third Object, July 6, W.65^{sec}, N.7′; July 7, W.68^{sec}, N.5′. It will be recalled that the great comet of 1882 expelled several portions. A sketch by C. L. Prince on Oct. 23 showed 4 nuclei (see Chambers' "The Story of the Comets", page 152, which also records that "on one occasion the comet seems to have thrown off a mass of matter which became, and for several days was observed as, a distinct comet").

Harvard Cards No. 224, 225, 227 give the following positions of comet 1932 *g* (Geddes). They are for the equinox of 1932·0. The observers at Cordoba were Dr. Bobone and Mr. Tretter; at La Plata, M. Dartayet. The magnitude was 9.

U.T.	R.A.	S.Decl.	Place.
June 25·9666	10h 43m 13·5s	81° 43′ 38″	La Plata.
27·0366	10 55 16·7	80 53 25	Cordoba.
27·9847	11 4 30·4	80 7 46	Cordoba.
29·0740	11 13 28·3	79 14 40	La Plata.

An erroneous position was given in *Card* 226; it is corrected in *Card* 227.

Hydrogen Content of the Stars.—Sir Arthur Eddington pointed out some years ago that the discordance between the calculated and observed brightness of the stars (the calculated one being about ten times too bright) could be removed by supposing a larger proportion of hydrogen in the stars than at that time seemed probable. He now gives reasons for believing that the proportion of hydrogen is actually large enough to remove the discrepancy (*Mon. Not. R.A.S.*, April). He shows that there are two solutions for the percentage of hydrogen, one 33 per cent., the other 99·5 per cent. He regards the smaller value as more probable, but does not absolutely rule out the larger one; five cases are worked out: the sun, Capella, Krueger 60, Algol, V Puppis. The agreement is close except in the case of the last star; it is suggested that the proportion of hydrogen may be greater in very massive stars.

Sir Arthur notes that a paper by Dr. B. Strömgren, which he did not receive until his own was nearly finished, deals with the same problem and reaches results in very good agreement with his. The existence of the second solution with the very high percentage of hydrogen was noticed by both investigators. Incidentally, Sir Arthur notes that he has changed his adopted value of the sun's absolute bolometric magnitude from 4·85 to 4·60.

A Hebrew Zodiac.—Mr. Moses B. Cotsworth, the well-known advocate of calendar reform, reproduces in his Pamphlet *W*, issued last year, a photograph of a zodiac, executed in mosaic work, which was discovered in 1929 under the ancient synagogue of Beth Alpha, in the valley of Jezreel; the date is conjectured to be the reign of the Emperor Justin, A.D. 518–527. Several of the figures depart considerably from the usual types. The Lion has its head towards the Virgin, the Scorpion towards the Archer, the Scales are in a man's hand (possibly to correct the anomaly that the Scales, being an inanimate object, break the circle of living things). The Hebrew names of the constellations are inserted, and several of them are distinctly legible in the reproduction: Shor the Bull, Ariyah the Lion, Bethulah the Virgin, Aqrab the Scorpion, Qesheth the Bow; the others are indistinct. Mr. Cotsworth states that a similar zodiac has since been discovered near Jericho. The late Mr. E. W. Maunder, in his "Astronomy of the Bible", collected several passages in the Old Testament that might be allusions to the signs of the zodiac; but this is the first distinctly Hebrew zodiac that has come under the notice of the writer of this note.

Annual Conference of the Museums Association

THE forty-third Annual Conference of the Museums Association was held at Birmingham on June 27–July 2, by invitation of the Lord Mayor and Corporation. This is the first time that the Association has visited the City. The University authorities very kindly placed lecture and office accommodation in Mason College, Edmund Street, at the disposal of the delegates, and here some two hundred members of the Association met under the presidency of Sir Henry Miers.

Owing to the prevailing financial conditions, the number of delegates was somewhat smaller than usual, but the Conference was noteworthy in that the social side was reduced to a minimum, and the numerous papers provoked animated, if not always appropriate, discussion.

In his presidential address, Sir Henry Miers gave an encouraging account of the past year's work. With the assistance of the Carnegie United Kingdom Trustees, grants have been made to certain municipal museums for the reorganisation of their collections, and short training courses for curators were held in London and Edinburgh. With the generous co-operation of the Carnegie Corporation of New York, surveys of museums in Canada and Africa were carried out by Sir Henry Miers and Mr. S. F. Markham, in the Mediterranean by the honorary treasurer and honorary secretary of the Association, and of the museums of Montreal by Dr. Cyril Fox, director of the National Museum of Wales. As a result of these surveys, directories of museums in Canada and Africa are in preparation which will contain data hitherto impossible to obtain even from the statistical departments of the appropriate governments.

Other matters of importance concerning museums which Sir Henry dealt with were co-operation between the national and provincial museums, and the expressed desire on the part of the national museums to assist so far as possible the small museums; the Board of Education pamphlet on "Museums and the Schools"; the work of the federations and the recent formation of a new federation, the South-Western Group of Museums and Art Galleries; co-operation with the British Broadcasting Corporation; and the improved status of the curator which is likely to result from the adoption of the diploma scheme. Sir Henry also commented on the increased usefulness of the *Museums Journal*, and reported that the membership of the Association had increased during the year from 516 to nearly 800.

At the conclusion of the address, the honorary treasurer (Alderman Charles Squire) presented Sir Henry with two bronze pieces of sculpture by Allan Howes, as a mark of the Association's appreciation of his services as president during the last four years.

Following the presidential address, Dr. G. F. Hill, director and principal librarian of the British Museum, opened a discussion on "Co-operation between National and Provincial Museums". He deplored the splitting up of collections and their subsequent distribution to different centres, as well as the retention locally of unique or historical specimens which fit properly into the series of our great national museums but obviously are out of place, unsafe, and lack true appreciation in the local museum. He also dealt with loan collections and the presentation of duplicates or casts and electrotypes to smaller museums by the larger institutions.

Subsequent speakers from the London museums elaborated these points, and their views appeared to meet with approval from their provincial colleagues. The remainder of the morning was occupied by Miss M. H. Keating's description of a travelling exhibition which she has prepared to illustrate child welfare work, and later in the day the delegates were able to inspect part of Miss Keating's exhibition.

Wednesday provided a varied programme of great interest. Dr. Alexander Scott described the work and methods of the British Museum laboratory in cleaning and restoring metal objects, and the results obtained, as illustrated by lantern-slides, aroused the enthusiasm of the audience and provoked numerous inquiries. Mr. S. L. Davison, of Port Sunlight, described the objects and methods of the Regional Federations of Museums, basing his remarks on his experience with the Lancashire and Cheshire Federation. "Modern Methods of Examining Pictures" was the subject of a delightful and practical exposition by Prof. A. P. Laurie, who made difficulties seem easy and constantly captured the admiration of his hearers by his wide knowledge of the history of pictures and artists. In the afternoon, Dr. L. J. Spencer explained how he illuminated the cases and specimens in the Mineral Department of the British Museum, and thus provoked a discussion of primary importance to the delegates. From the consideration of the lighting of museum cases to that of the illumination of a child's mind is no mean step, but the audience accomplished the transition safely and pleasantly under the guidance of Miss M. Champness, who described her work in the Newbury Museum.

From the subsequent discussion it appears that most curators are agreed that the handling of specimens by the child is of primary importance, while the 'once upon a time' method of telling a story, the provision of seats for the small listeners, and, if possible, the use of a special room away from adult interference, all contribute to the success of the instructional classes.

Most of Thursday morning was devoted to the annual business meeting, but the Association welcomed Mr. R. A. Rendall, of the B.B.C., who inaugurated a discussion on broadcasting and museums. Mr. Rendall outlined the educational policy of the Corporation, and hoped that the art galleries and museums might assist the broadcast of talks by arranging cognate exhibits, or by installing a loud-speaker in the institution for the benefit of organised discussion groups.

The morning of the last day of the Conference was devoted to a summary, by Mr. G. H. Hill, of publicity methods and extension work as at present practised by museums, and to Mr. D. Payler's description of his work in the Birmingham Museum in preparing economic and other exhibits. Dr. Cyril Fox, as chairman of the Education Committee, outlined the newly prepared scheme for a diploma to be awarded to curators after examination. Space does not permit the explanation here of the detailed proposals, but the scheme found favour, as it is definitely practicable and is based on a high enough standard to ensure the recognition of the diploma as a sound educational and curatorial qualification.

An official visit was paid by the Conference to the Museum and Art Gallery, where the delegates enjoyed the magnificent art collection and the pleasing habitat groups of birds and mammals under the guidance of Mr. S. C. Kaines Smith, the keeper, and Mr. Donald Payler, respectively. An unusually large trade exhibition was also staged in the Art Gallery.

Chemical Societies and Co-operation

IN his presidential address to the Society of Chemical Industry at Nottingham on July 13 under the title "Ourselves and Kindred Societies", Prof. G. T. Morgan discussed various aspects of the problem of re-union or co-operation among societies concerned with the furtherance of the professional and scientific welfare of chemists. The original territorial organisation of the Society of Chemical Industry in local sections holding their own meetings and other activities has in recent years been supplemented by the inception of subject groups, commencing with the Chemical Engineering Group in 1918.

Two such groups, the Food Group and the Plastics Group, have been formed during the past year, and this development alone is one which induces consideration of the relations of the Society with certain specialist societies and the possibility of such fusions or federations as was witnessed in 1882, when the Newcastle Chemical Society threw in its lot with the Society of Chemical Industry, and again this year, between the Food Group and the Society of the Food Industry.

An analysis of fourteen out of the sixteen separate societies concerned with the scientific and professional interests of chemists shows that the societies in 1930 had a total membership of 23,605 and a combined income from subscriptions of £46,557. Ignoring the fact that many individuals were members of several societies, the average annual subscription is thus about £2, the expenditure of which is divided as follows: 32·5 per cent for scientific literature, 6·5 per cent on social amenities, 6 per cent on library facilities, and 55 per cent on administration. This latter high proportion is attributed to the reluctance of chemists to assume such functions, and while paying tribute to the efficiency of administration of the societies generally, Prof. Morgan suggested that an important means of reducing this proportion of expenditure would be found in the societies drawing closer together and centralising or simplifying office appointments as losses from the staffs occurred through retirement, resignation, or other causes.

So far as the publication of scientific literature is concerned, the main burden is shared by the Chemical Society and the Society of Chemical Industry, and the formation of the Bureau of Chemical Abstracts already represents a measure of co-operation between the two Societies which, by eliminating duplication, adoption of a single format and index, etc., has enabled them to deal with the increasing volume of literature which requires abstracting. Attempts to organise an Anglo-American scheme have so far fallen through, but if the fourteen societies could collaborate in technical publication and pool their financial resources, there appears to be every prospect of the Bureau being able to deal effectively with the steadily increasing number of original memoirs in all branches of chemistry, unembarrassed by financial anxiety.

Following this step of co-operation in abstracting, Prof. Morgan suggested that the publication of joint in place of individual transactions would be a further economy. The steps recently taken by the Faraday Society and the Chemical Society for publishing ordinary contributions to the Faraday Society and physico-chemical papers of the Chemical Society as a new joint journal is an example that might well be followed. Similarly, the possibility of a joint chemical newspaper which would replace the more ephemeral part of *Chemistry and Industry* might also be well worth exploring. This journal would be able to present a wide survey of current topics of personal interest to English-speaking chemists, as well as including progress reports and summaries of scientific researches, and affording a suitable medium for the publication of the jubilee lectures or the lectures now arranged by the Institute of Chemistry on modern developments in the main branches of chemistry.

Improvement of library facilities, research facilities, and vocational education in chemistry are other matters that might be expected to follow the reunion or rationalisation of the profession. Effective action can, however, only be expected when, as Prof. Morgan pointed out, the members of the individual societies face the problem from the point of view of the well-being of the profession as a whole and not of the interests of an individual society.

Sunset Glows and the Andean Eruptions

ATTENTION was directed in NATURE of June 25, p. 932, to a report from Johannesburg of sunset afterglows in South Africa following the eruptions in the Andes last April. Two other correspondents have been kind enough to send further extracts from letters from the same place. Mr. A. Stanley Pye-Smith, 51 Wickham Road, Beckenham, Kent, sends the following extract from a letter dated May 3: "We are having very wonderful sunrises and sunsets, as a result of the volcanic dust from South America. The sky glows red long after the sun is visible, while there are no clouds at all to catch the light, as far as one can see. It is a pleasant change to have prolonged light in this latitude where darkness falls so quickly." Miss Cecilia F. O'Connor, 402 Milton Road, Cambridge, has sent extracts from a letter, dated May 4, received from her brother, Mr. E. R. O'Connor, Germiston, Transvaal, which give more precise details, stating that "at sunset the colours are magnificent, but it is about an hour later when they are best. Normally at that time it is pitch dark. But now the western sky is lit a flaming red light to the zenith—as though there were a huge volcano belching out volumes of fiery smoke. The red light is so powerful that everything catches a reflected tint, but yet you can see stars shining through, even to the west! What clouds there are, are etched in flame, and, towards the zenith, the red shades through purple to the ink blue of night." The same writer in a further letter, dated May 18, describes the sunsets as appearing to get finer, possibly because of the unsettled weather.

A letter, dated May 20, since received from Dr. E. Kidson, director of the Meteorological Office, Wellington, New Zealand, suggests that the volcanic dust had travelled on with the prevailing westerlies to New Zealand early in that month; it is probable therefore that the complete circuit of the southern temperate zone has long since been completed. Dr. Kidson describes the sunset afterglows that began about the end of the first week in May as very beautiful, ranging in colour from pale pink to yellowish pink in the western sky, the appearance showing a certain amount of structure suggestive of thin high smoke. Several reports of unusual manifestations of halo or corona have been received by his Department.

A particularly interesting point to which Dr. Kidson directs attention is that daily determinations of the intensity of the solar radiation at noon, made with the aid of an Ångström pyrheliometer, showed a sudden decrease of about ten per cent on May 5 and a slight recovery since. As an effect of this kind is likely to be general over the region affected by volcanic dust at high levels, it appears probable that the excess of solar radiation now being received by the earth's surface over the northern as compared with the southern hemisphere, on account of the season, is distinctly greater than usual. Although some effect on the weather is probable, it would be unsafe to refer abnormal weather at a particular place to this source, and there are not enough meteorological observatories at present to allow of a comparison between average weather conditions in the two hemispheres before and since the eruptions, in order to trace their effects.

E. V. N.

The Laboratory for Fresh Water Biological Research on Windermere

In Great Britain, research on fresh water biological problems has, for many years, suffered from the lack of adequate laboratory facilities—a curious fact since so much valuable pioneer work has been done in the British Isles, particularly on the lakes. The opening, last September, of a laboratory under the control of the Fresh Water Biological Association of the British Empire has removed this drawback, and investigators wishing to pursue the various branches of fresh water research can now be assured of obtaining the requisite facilities.

The laboratory is situated in Wray Castle, about three miles from Ambleside and on the north-west shore of Windermere. The lake reaches its maximum depth, just over seventy metres, about a quarter of a mile from the boat-house, and different types of inflowing streams and of shore lines are within a convenient distance. There is also a large number of streams and of smaller bodies of standing water within a short distance of the laboratory, these including examples of very diverse types, while almost the whole range of British fresh water habitats can be found within a distance of fifteen miles. There is thus abundant scope for biologists interested in plants or animals of special groups or in their habitat conditions.

The laboratory is equipped for most of the usual types of biological research. It contains ample facilities for microscopical and for experimental work, both purely physiological and also chemical. Gas for heating purposes is provided from a petrol-air installation. There is a large range of basement cellars which are used for aquaria or for storage purposes, while dark rooms are also available. The usual equipment for plankton investigation is provided, and for this and other forms of lake work a motor launch is available, as well as a smaller boat. This launch is a twenty-four-foot sea-going pinnace, fitted with gears so that very low speeds can be maintained for dredging operations. It also has a derrick and a winch driven by the motor for lifting heavy apparatus. The launch is provided with electric light and navigation lights for night work.

Persons working in the laboratory can obtain a variety of accommodation in Ambleside, and simple accommodation is available in the Castle itself, rooms having now been fitted up for this purpose. Inquiries about working places and research facilities may be made to the Naturalist-in-charge, Wray Castle, Ambleside, Westmoreland, or to the Honorary Director, Dr. W. H. Pearsall, The University, Leeds.

The Neutron

A group of three important papers on the production and properties of neutrons has appeared in the June number of the *Proceedings* of the Royal Society. The first, by J. Chadwick, is an account of his own experiments and a general discussion of the problems involved.

The experiments are in principle quite simple. Beryllium or boron is exposed to the α-particles of polonium, and the resulting penetrating radiation, probably a mixture of γ-rays with neutrons, examined with an electrical particle counter. The neutron has the property, otherwise only associated with radiation quanta, of being recorded by the secondary ionising action of some particle with which it has collided—in this case usually, if not invariably, the nucleus of an atom. Apart from the use of one of the new forms of electrical counters, the main point of the experiments seems to be that a very strong preparation of polonium is required.

Amongst the interesting questions which are touched upon in Dr. Chadwick's survey are the effective collision area which various nuclei offer to a neutron and the allied problem of the nature of the interaction. Dr. Chadwick finds by direct experiment that both for light and heavy nuclei the effective area is not much different from the usually quoted values for the size of the nucleus, and since experiments with lead indicate that neutrons are scattered about equally well in all directions, he suggests that the interaction may occur well inside the nucleus, which is in accord with the very limited region throughout which a neutron would be expected to have an appreciable field.

The other papers, by N. Feather and P. I. Dee, are concerned with the application of the Wilson cloud chamber to the problem. Dr. Feather has obtained a number of photographs of the collisions between neutrons and nitrogen nuclei, in which, on account of its negligible interaction with electrons, the neutron itself does not give a trail. The collisions appear to be of several types. In some, presumably elastic, there appears only the short, heavily ionised trail of the fast nitrogen nucleus which has been set in motion. The inelastic collisions were of two main types, in the first of which the neutron is captured and an α-particle liberated, whilst in the second the neutron is not captured but probably a proton liberated.

Mr. Dee's contribution is a search for visible evidence of the interaction of neutrons with the electrons of molecules in the air, using a most carefully adjusted Wilson chamber. This was not found, and the quantitative formulation of his results shows that the probability of interaction of a neutron with an electron, with the production of a recoil electron track, is less than one per cent of the probability of similar interaction with a nitrogen nucleus. The ionisation along the path of a neutron is given as less than one ion pair in three metres of air.

University and Educational Intelligence

Aberdeen.—The University Court has decided that in future the professor of surgery shall devote the greater part of his time to the duties of the chair, and that his private practice will be limited to cases seen and treated in Aberdeen—with rare exceptions. It is understood that preference will be given to those candidates of wide experience of clinical surgery and acknowledged power of teaching who, by their special training and record, have given evidence of their capacity for and interest in research. The appointment to the chair is made by the Crown on the recommendation of His Majesty's Secretary of State for Scotland.

THE following appointments have been made at Armstrong College, Newcastle: Dr. H. L. Riley to be professor of inorganic and physical chemistry; Prof. G. R. Clemo to be director of the Department of Chemistry.

A CHELSEA Polytechnic Old Students' Association is to be inaugurated at a meeting to be held on Nov. 4, on the occasion of the opening of the Polytechnic extension by the Parliamentary Secretary to the Board of Education, Mr. H. Ramsbotham, M.P. Old students wishing to be present at the meeting, or who desire particulars of the Association, should address communications to the Honorary Secretary, Chelsea Polytechnic Old Students' Association, Manresa Road, Chelsea, S.W.3.

DR. C. B. MARSON has been appointed head of the Chemistry Department of the Hull Municipal Technical College. Dr. Marson received his early training as an analytical chemist with Capt. J. A. Foster of Hull, and was for some time in the laboratories of the British Thomson-Houston Company at Rugby. After War service, he took a course in fuel and metallurgy at the University of Leeds, leading up to the B.Sc. degree, and for two years held the gas research fellowship of the Institution of Gas Engineers, working on the influence of inorganic constituents on the properties of coke. He was then appointed on the staff of the Joint Research Committee of the University of Leeds and the Institution of Gas Engineers, from which he proceeded to the position of chief chemist to the Northern Coke Research Committee.

SCHOOL buildings obviously condition the efficiency of school work just as factory buildings condition industrial efficiency in ways that admit of exact measurement, and the methods of investigation which the National Institute of Industrial Psychology has applied with notable success in the latter field are now being applied, on the initiative of the National Union of Teachers, in the former. The N.U.T. has issued a pamphlet containing a report, presented at a recent conference of local education authorities, on the progress of the enterprise. The problems dealt with include lighting, ventilation, heating, seating, staff rooms, workshops, playgrounds, cloakrooms, and blackboards, but the report is concerned chiefly with lighting. Exact measurements have demonstrated the supreme importance of good illumination, owing to its twofold influence in decreasing the time required for perception and in decreasing nervous and ocular strain, with consequent improvement in both quantity and quality of work. The value of window cleaning (so justly emphasised in a less enlightened age by that underrated educationist, Dr. Squeers) assumes a new importance when exhibited in graphs and percentages, and surprisingly good results are shown to be obtainable by attention to the amount of light reflected from furniture and walls. Some of the diagrams used are reproduced from "Seeing", by M. Luckeish, director of the Lighting Research Laboratory, Cleveland, U.S.A.

A SCIENTIFIC basis for national development was the aim of Senator Morrill, the promoter of the remarkable movement which, seventy years ago, brought into existence the 'land-grant' universities and colleges of the United States of America. In a summary—published as *Bulletin* No. 20, 1931, of the Office of Education, Washington—of an exhaustive report on these institutions, it is claimed that this aim has been achieved, and that they not only have added enormously to the nation's wealth, but also have helped to develop a new concept: government by science. By humanising scientific knowledge, they have, it is said, immeasurably improved the social life of millions of citizens who otherwise would tend to isolation from more favoured groups. The aggregate amount of their annual budgets exceeds one hundred million dollars, and their student enrolment exceeds three hundred thousand. Obviously they must have been and still are a potent factor in American culture, but as for the claim that they have achieved Morrill's object, this cannot easily be reconciled with Prof. John Dewey's contention in "Philosophy and Civilisation" (reviewed in NATURE of March 5) that the "disorder, confusion, and insecurity" characteristic of American social life are due to "our half-way and accidental use of science". In the same bulletin are summarised the results of another important national survey, that of negro colleges and universities, and a description is given of the purpose and organisation of three others now under way, those of secondary education, the education of teachers, and school finance.

Calendar of Geographical Exploration

July 24, 1862.—Central Australia

J. M. Stuart reached the coast of north Australia at the mouth of the Adelaide River near Port Darwin, thus achieving his aim of a land journey from south to north of the continent. Stuart's explorations began in 1858 in the country north of Lake Gairdner; in 1860 he discovered the Alberga and Finke Rivers and the MacDonnell range of mountains.

July 26, 1529.—Discovery of Peru

Francisco Pizarro was appointed governor of the newly discovered regions in Peru (New Castile). Pizarro had accompanied Balboa in the discovery of the Pacific and had there heard of the gold of Peru. In 1524 he had sailed from Panama and after three years of hardship reached the River San Juan. From that river one of his officers, Bartolomé Ruiz, set out in a small ship, crossed the equator, and sighted Peru. He brought back glowing reports of its gold and silver, and this led Pizarro to return to Spain to obtain help from the Emperor, Charles V. He started his return journey from San Lucar in 1530 and at the beginning of 1531 was *en route* for Cajamarca. By the end of 1533, Pizarro, like Cortes, sent out numerous exploring parties, the marches of which opened up much of the interior of South America.

July 27, 1767.—Discovery of Tahiti

Capt. Samuel Wallis left Tahiti (Otaheite), which he had discovered and where he made a long stay, sending an exploring party to the interior which reported on its great fertility. Various other small islands were discovered by Wallis on this voyage, which lasted from 1766 until 1768.

July 30, 1774.—South Russia and Siberia

P. S. Pallas returned to St. Petersburg after a journey which had lasted since June 21, 1768. He first investigated South Russia and the Caspian region. Later he wintered at Tobolsk, and then carried out researches into the morphology of the Altai Mountains and the region of the Upper Irtish. In 1772 he crossed Lake Baikal and explored the Upper Amur, and in the following year worked in the region of the Lower Volga. His observations helped to elucidate the problem of the origin of mountain ranges; he also collected much information about the natural history and economic conditions of the regions he studied.

Societies and Academies

LONDON

Mineralogical Society, June 7.—**J. E. Drugman** and **Max H. Hey**: Legrandite, a new zinc arsenate. A yellow transparent mineral on a single specimen of blende proved to be a new zinc arsenate. Chemical, optical, goniometric, and X-ray measurements were made, and the name legrandite is proposed for the new mineral, the formula of which is $Zn_{14}(AsO_4)_9OH.12H_2O$.—**W. F. P. McLintock**: The metamorphism produced by the combustion of hydrocarbons in the Tertiary sediments of south-west Persia. At various localities in south-west Persia, the escape and combustion of gas or oil have resulted in the brecciation, partial fusion, and crystallisation of calcareous marls with the formation of crystalline rocks consisting of pyroxene (diopside, ægirine-augite, and ægirine), wollastonite, pseudo-wollastonite, bytownite, melilite, and leucite, with glass, recrystallised calcite, and anhydrite. In the field, the rocks resemble vesicular igneous types, but microscopic examination and chemical analyses, accounts of which are given, prove them in all cases to be metamorphosed sediments.—**F. A. Bannister**: The determination of minerals in platinum concentrates from the Transvaal by X-ray methods (with chemical analyses and syntheses by **M. H. Hey**). X-ray rotation photographs have been used to distinguish and select for chemical analysis the various platinum- and palladium-bearing minerals present in the concentrates of Bushveld platinum ore. The name cooperite is retained for PtS, tetragonal, space-group D_{4h}^9. The face-centred unit cell with edges $a=4{\cdot}91$, $c=6{\cdot}10$ A., contains 4PtS. The atomic co-ordinates for platinum in this cell are $\frac{1}{4}\,\frac{1}{4}\,0$; $\frac{3}{4}\,\frac{3}{4}\,0$; $\frac{1}{4}\,\frac{3}{4}\,\frac{1}{2}$; $\frac{3}{4}\,\frac{1}{4}\,\frac{1}{2}$, and for sulphur: $0\,0\,\frac{1}{4}$; $0\,0\,\frac{3}{4}$; $\frac{1}{2}\,\frac{1}{2}\,\frac{1}{4}$; $\frac{1}{2}\,\frac{1}{2}\,\frac{3}{4}$. The structure is a simple type of fourfold co-ordination built up from plane PtS_4 groups and tetrahedral SPt_4 groups, the Pt-S distance being 2·32 A. Synthetic PtS has been prepared and is identical with the mineral cooperite. Laurite (RuS_2) occurs in small pyritohedral-cubic crystals and has the pyrite structure with unit-cell edge $a=5{\cdot}59$ A. The third mineral, $PtPdS_2$, containing about five per cent Ni, is also tetragonal with unit-cell edges $a=6{\cdot}37$, $c=6{\cdot}58$ A. The unit cell contains $4PtPdS_2$ and the space group is D_{4h}^1. The name braggite is proposed for this mineral as being the first discovered by X-ray methods.—**John Parry, Alpheus F. Williams**, and **F. E. Wright**: Bultfonteinite, a new fluorine-bearing hydrous calcium silicate from South Africa. This new mineral was found in the Bultfontein and Dutoitspan diamond mines at Kimberley and in the Jagersfontein mine in Orange River Colony. It forms pale pink globular aggregates of radiating needles, and has much the appearance of natrolite. Analysis gives the formula $2Ca(OH,F)_2.SiO_2$. From the manner in which the mineral is decomposed by water and by dilute acids, a formula written as $Ca(OH)_2SiO_2.Ca(OH,F)_2$ is suggested. Goniometric and optical examination of the minute crystals shows them to be triclinic, but much complicated by polysynthetic twinning. The mineral is related to afwillite with the addition of $Ca(OH)_2$ and CaF_2, and the nearest ally is custerite $[CaO.Ca(OH,F)_2,SiO_2]$.

Geological Society, June 16.—**L. R. Wager**: Geological work in East Greenland during the British Arctic Air-Route Expedition, 1930–31. The winter base of the expedition was in the Angmagsalik district and most of the geological work was carried out there and also in the course of two journeys. The first journey was northwards for 300 miles along the coast to Kangerdlugsuak, and the second along the edge of the ice-cap to Mount Forel. The Angmagsalik district consists of gneisses and schists for which the name Metamorphic Complex is used, since the Archæan age of these rocks cannot be proved. The coastal zone between the ice-cap and the sea north of Angmagsalik consists of high mountains and includes Mount Forel, the highest mountain within the arctic. These mountains have been cut from a raised peneplain which passes without interruption from the Metamorphic Complex to the Tertiary basalts and plutonic intrusions. The peneplain has a gentle dip to the south-east or east-south-east, and to this is due the general trend of the coast and of one group of valleys and fjords. The inland ice has recently receded, and its present action may be studied side by side with its effects on the recently uncovered mountainous surface.

Physical Society, July 8.—**J. J. Manley**: On the determination of refractivity temperature coefficients for liquids. Attention is directed chiefly to the problems of measuring with precision the changes in the refractivity of a liquid for small alterations in temperature. An elaborated Jamin interferometer is described, with auxiliary apparatus necessary for setting up and maintaining differences in the temperature of the two interferometer tubes. Further, there is given a plan for measuring by means of platinum resistance thermometers differences in the temperatures of the two tubes.—**N. W. McLachlan**: (1) The axial sound-pressure due to diaphragms with nodal lines. A formula is found for the axial sound-pressure due to a disc having a nodal circle, and vibrating in an infinite rigid plane. Beyond a certain axial distance, when the nodal circle occurs at $r=a/\sqrt{2}$ the pressure vanishes owing to interference caused by the inner and outer portions of the disc vibrating in opposite phase. The case of n nodal circles of arbitrary radii is treated by an approximate method. A rigid disc is imagined to be severed around each nodal circle, whilst contiguous annuli vibrate with equal amplitudes in opposite phase. Finally the pressure on the axis of a conical shell having nodal circles is treated as in the previous case. When the semi-apical angle of the cone is $\frac{1}{2}\pi$ and there are no nodal circles, the formula reduces to that for a rigid disc.—(2) The accession to inertia of flexible discs vibrating in a fluid. Formulæ are obtained for the velocity-potential at the surface of a free-edge disc vibrating with nodal lines in a fluid. These formulæ are used to ascertain the accession to inertia due to the fluid when the disc is set in an infinite rigid plane. The equivalent mass and the mass coefficient of the disc vibrating *in vacuo* are also found; and the influence of the fluid on the frequency of vibration with (*a*) one nodal circle, (*b*) one nodal diameter, (*c*) stationary centre, is evaluated.—**A. J. Bradley** and **A. H. Jay**: A method for deducing accurate values of the lattice spacing from X-ray powder photographs taken by the Debye-Scherrer method. The usual circular type of camera is employed; and there are two stages in the procedure, (*a*) the calibration process, (*b*) the extrapolation process.—**G. Millington**: Ionisation charts of the upper atmosphere. Prof. Chapman's theory of the ionisation of the upper atmosphere by solar radiation has been applied to construct a set of charts giving contour lines of equal ionic density over the surface of the earth. A simple approximate method of solving the fundamental differential equation of the theory by a rapid arithmetical process is described.—**A. S. Rao**: Further investigations of the arc spectrum of arsenic. By photographing the spectrum of arsenic by the method of the hollow cathode discharge in helium and in neon about a hundred new lines have been recorded. The analysis of As I published by previous investigators has been considerably altered

and extended. New levels have been added and the higher members of the chief groups of the series of *ms* terms have been identified. A mean value of 85,000 cm.$^{-1}$ has been suggested for the deepest term $4p\ ^4S_2$ which leads to a first ionisation potential of approximately 10·5 volts for arsenic.

EDINBURGH

Royal Society of Edinburgh, June 6.—**L. M. Davies**: The genera *Dictyoconoides* Nuttall, *Lockhartia* nov., and *Rotalia* Lamarck. The original types of Carter's *Dictyoconoides* [*Conulites*] *cooki*, which have recently been found after having been lost for nearly thirty years, are described and figured; also the original types of Lamarck's *Rotalia trochidiformis*, from the Defrance collection at Caen. The characters and relationships of these species are discussed; and a certain number of other species, hitherto referred to *Dictyoconoides*, are removed to a new genus *Lockhartia*.—**E. B. Bailey** and **J. Weir**: Submarine faulting of Kimmeridgian date. During Kimmeridgian times a submarine fault scarp was maintained by intermittent movement of the sea floor of the Helmsdale district of East Sutherland. Unconsolidated Mesozoic rocks on the upthrow side of the fault dissipated without yielding boulders, but Old Red Sandstone exposed in the fault scarp furnished repeated landslips, carrying boulders that in exceptional cases measured 100 feet in length. Earthquakes were frequent, for the landslips are almost always spread out into graded boulder beds in a manner indicating co-operation of tunamis ('tidal waves'). The Helmsdale movement can be brought into relation with the general history of contemporary Britain, more particularly with the fissuring of Kimmeridgian at Ethie on the Moray Firth and the development of the Camasunary fault in Skye.—**T. Johnson**: The Tertiary plants of Ireland and Scotland: a comparative account—(1) Thallophyta to Gymnospermæ. The paper deals with collections of fossil plants from the north-east of Ireland, including those found at various depths (780-930 ft.) in the core of a bore made at Washing Bay at the south-west corner of Lough Neagh, and with collections of more or less contemporaneous plants from the Hebrides, including a small collection from the Isle of Canna and another from a site discovered by Mr. I. A. Inglis in the Isle of Skye.—**Mary H. Latham**: Scottish Carboniferous Ostracoda. The specimens come from one hundred and forty different localities in the Carboniferous of Scotland and England. Most of the species appear to have quite a long range, few of them being restricted to one horizon, although some occur only in the Upper Limestone Series of the Scottish Carboniferous and others are confined to the Lower Limestone Series.—**Ian M. Robertson**: A study of the tyrosinase of potato tubers. With *p*-cresol as substrate, the tyrosinase present in potato tubers produces a bright orange-red colour. The kinetics of the reaction have been studied by treating tuber sections with aqueous solutions of *p*-cresol in caustic soda and measuring the colour changes by means of Lovibond colour standards. The course of the reaction is monomolecular, with initial and final linear periods. The activity of the enzyme is independent of such factors as soil and environmental conditions of growth, season, and storage, but is dependent upon tuber maturity, disease, and variety. The test has been applied successfully towards the determination of the variety of healthy, mature tubers.

PARIS

Academy of Sciences (vol. 194, pp. 1993-2092), June 6.—**G. Urbain**: An attempt at a co-ordinative theory of the constitution of organic compounds.—**C. Camichel, P. Dupin**, and **M. Teissié-Solier**: The non-turbulent regime beyond the criterion of alternate vortices.—**Lucien Daniel**: New researches on the descent of certain grafted Compositæ.—**Ehresmann**: The integral invariants and the topology of ruled projective space.—**D. V. Jonesco**: Certain curves which generalise conics.—**Rud. Fueter**: Hermite forms, Picard group, and the theory of quaternion ideals.—**M. Ghermanesco**: The problem of Riquier.—**Arnaud Denjoy**: The characteristics of the torus.—**Alex. Froda**: The vertical measurability of functions of real variables.—**J. Le Roux**: The differential invariants of groups of relativity.—**J. Haag**: The general theory of the elastic suspension of pendulums.—**G. Siadbei**: The measurement of the resistance opposed by a viscous medium to the movement of bodies.—**J. Rossignol**: The problem concerning cylindrical vortices of finite section.—**André Douillet**: An apparatus with elastic coupling for measuring and recording graphically rotation couples.—**Émile Belot**: The original and present orientation of the orbits of the minor planets and of Jupiter in relation with the causes of the primitive eccentricities.—**D. Eginitis**: An error of Posidonius and its influence on the discovery of America.—**L. Néel**: The magnetic susceptibility of sulphur vapour. The diatomic molecule of sulphur is paramagnetic, and its properties are clearly different from those given by the theory applicable to oxygen.—**J. Lecomte**: An attempt at the co-ordination of the infra-red absorption bands of some hydrocarbons with nucleus.—**Maurice Curie** and **Jean Saddy**: Phosphorescent sulphides. Extinguishing action of the metals of the iron group. Traces of cobalt or iron reduce or prevent the phosphorescence of zinc sulphide. Lead is without influence.—**Marcel Cau**: The interpretation of a magneto-optical effect.—**Jacques de Lassus Saint-Genies**: A partial solution of integral photography.—**W. Broniewski** and **K. Wesolowski**: The gold-silver alloys as a type of continuous solid solutions. A study of 15 physical properties of gold-silver alloys as a function of the composition of the alloy. The results are given graphically.—**A. Michel-Lévy** and **H. Muraour**: Certain substances modifying the double refraction of the nitrocelluloses.—**F. Bourion** and **Mlle. O. Hun**: The cryoscopic study of ether and acetone in solutions of potassium chloride.—**Desmaroux** and **Mathieu**: Remarks on the structure of films of nitrocellulose with high nitrogen content.—**Paul Renaud**: A mineral india-rubber. Phosphorus chloronitrides of the constitution $(PNCl_2)_n$ on heating in sealed tubes to 270° C. polymerise, giving rise to substances possessing some of the properties of india-rubber.—**G. Darzens** and **André Lévy**: A new synthesis of eudaline (methylisopropylnaphthalene).—**A. Hodaghian** and **R. Levaillant**: The action of lithium hydride on benzoyl chloride. The main primary product is probably benzaldehyde, but this is polymerised, giving benzyl benzoate as the main product.—**Marcel Godchot** and **Max Mousseron**: 2-Aminocyclopentanol and its resolution into its optical antipodes.—**Lucien Semichon** and **Michel Flanzy**: The application of chromic acid oxidation to some diacids.—**L. Palfray, S. Sabetay**, and **Mlle. Denise Sontag**: α-Vinylnaphthalene and the polyvinylnaphthalenic resins.—**Charles Dufraisse** and **Robert Vieillefosse**: The application of the anti-oxygen effect to the problem of fighting fire. The extinction of charcoal in the presence of oxygen. The vapours of carbon tetrachloride or phosphorus oxychloride have a real anti-oxygen effect on burning charcoal.—**Georges Laude**: The synthesis of cyanic acid and of urea by the ammoniacal oxidation of carbonaceous substances. A modification of the methods previously described, giving higher yields of urea and cyanic acid.—**R. Bureau**: Goniometric

researches on atmospherics.—**Pierre Gavaudan**: The identity of the metachromatic vacuome and of the leucosine of the Monadineæ and Chrysomonadineæ.—**A. Damiens** and **Mlle. S. Blaignan**: Normal bromine in plants: edible plants and fruits. Bromine is a normal constituent of plants, the amount in 100 grams of dry material varying between 0·17 and 2·02 mgm. The amount in the fruits is less.—**Ph. Joyet-Lavergne**: The rôle of the chondriome in the manifestations of cytoplasmic sexualisation.—**A. Magnan** and **A. Sainte-Laguë**: Flight by wing beats at a fixed point.—**Philippe Fabre**: The exciting efficacy of condenser discharges below the rheobase.—**Mme. Phisalix**: The reciprocal vaccinating action of the poisons of the bee and *Vipera aspis*.—**R. Legroux**, **Kemal-Djemil**, and **Mme. Colette Jéramec**: The immunisation of guinea-pigs against glanders.—**J. Lignières**: Paradoxical phenomena of the immunising property of the aphthous virus. A local aphthous lesion does not always confer immunity.

Forthcoming Events

TUESDAY, JULY 26

BRITISH MEDICAL ASSOCIATION — Centenary Meeting (Presidential Address at the Queen's Hall, Langham Place, London). — The Right Hon. Lord Dawson of Penn: "A Hundred Years and After", at 4 P.M.

FRIDAY, JULY 29

BRITISH MEDICAL ASSOCIATION — Centenary Meeting (Popular Lecture at University College, Gower Street, W.C.1).—Prof. Julian Huxley: "The Biology of Human Nature", at 8 P.M.

Official Publications Received

BRITISH

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1931. Part 1, with Report of the Geological Survey Board and Report of the Director. Pp. iii+81. (London: H.M. Stationery Office.) 1s. 6d. net.

Proceedings of the Royal Irish Academy. Vol. 41, Section B, Nos. 1 and 2: Some Derivatives of Dicoumarin, by Dr. Joseph Algar, Anne E. O'Reilly and Mary Joy; Derivatives of Benzo-Difurfurane, by Dr. Joseph Algar, Vincent C. Barry and Tadhg F. Twomey. Pp. 14. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

University of Durham: Committee of Senate on Entrance Tests and Bachelors' Degrees. Report. Pp. 17. (Durham.)

British Standards Institution. No. 457, 1932: British Standard Specification for the Identification of Chemical Pipe Lines. Pp. 8. (London: British Standards Institution.) 2s. net.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (New Series), No. 5, May. Abstracts Nos. 747-933. Pp. 141-176. (London: H.M. Stationery Office.) 1s. net.

Madras Fisheries Department. Administration Report for the Year 1930-31. By Dr. B. Sundara Raj. (Report No. 1 of 1932, Madras Fisheries Bulletin, Vol. 26.) Pp. v+112. (Madras: Government Press.) 14 annas.

India: Meteorological Department. Scientific Notes, Vol. 4, No. 43: On the Extreme Dryness observed at Kodaikanal during the Winter Months. By S. L. Malurkar. Pp. 137-144+11 plates. (Calcutta: Government of India Central Publication Branch.) 1.8 rupees; 2s. 6d.

Proceedings of the Geologists' Association. Edited by G. S. Sweeting. Vol. 43, Part 2, 24th June. Pp. 97-200. (London: Edward Stanford, Ltd.) 5s.

The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report (Nineteenth Year) 1931, East Malling Research Station, 1st January 1931 to 31st December 1931. Pp. 89+5 plates. (East Malling.)

Indian Journal of Physics, Vol. 7, Part 1, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 15, Part 1. Conducted by Sir C. V. Raman. Pp. 106. (Calcutta.) 1.8 rupees; 2s.

Report by the Financial Commissioner (Lord Moyne) on certain Questions in Kenya. (Cmd. 4093.) Pp. vi+122. (London: H.M. Stationery Office.) 2s.

The London School of Economics and Political Science (University of London), Houghton Street, Aldwych, W.C.2. Department of Business Administration, Session 1932-33. Pp. 28. Training for Business Management. Pp. 11. (London.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1440 (T. 3116, 3117): Stresses in a Wire Wheel with Non-Radial Spokes under Rim Loads. Part 1, by Prof. A. J. Sutton Pippard and Miss M. J. White; Part 2, by Prof. A. J. Sutton Pippard and W. E. Francis. Pp. 19+19 plates. 1s. 3d. net. No. 1455 (T. 3201): Sideslip and Performance of Multi-Engined Aircraft. By E. T. Jones. Pp. 6+4 plates. 6d. net. (London: H.M. Stationery Office.)

Experimental Researches and Reports published by the Department of Glass Technology, the University, Sheffield. Vol. 14, 1931. Pp. iii+174. (Sheffield.) 7s. 6d.

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1932. Pp. xii+64. (Aberdeen.)

City and Guilds of London Institute. Report of the Council to the Members of the Institute, 1932. Pp. xlix+75. (London: Gresham College.)

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1931. Pp. 18. (London: H.M. Stationery Office.) 6d. net.

Mines Department. Tenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1931. Pp. 95+9 plates. (London: H.M. Stationery Office.) 2s. net.

Proceedings of the Royal Society of Victoria. Vol. 44 (New Series), Part 2. Pp. 103-326+plates 15-26. (Melbourne.)

Transactions of the Optical Society. Vol. 33, 1931-32, No. 3. Pp. ii+73-136. (London: Optical Society.) 10s.

Society of Biological Chemists, India. Biochemical and Allied Research in India in 1931. Pp. 42. (Bangalore: Indian Institute of Science.)

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 3: Some Legendary and Historical References to Irish Woods, and their Significance. By A. C. Forbes. Pp. 15-36. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

FOREIGN

Bulletin of the American Museum of Natural History. Vol. 64: The Distribution of Bird Life in Guatemala; a Contribution to a Study of the Origin of Central American Bird-Life. By Ludlow Griscom. Pp. ix+439. (New York City.)

U.S. Department of Agriculture. Technical Bulletin No. 294: The Biology and Morphology of the Braconid *Chelonus annulipes* Wesm. a Parasite of the European Corn Borer. By Arlo M. Vance. Pp. 48. (Washington, D.C.: Government Printing Office.)

University of California Publication. Bulletin of the Department of Geological Sciences, Vol. 21, No. 7: The Fossil Passerine Birds from the Pleistocene of Carpinteria, California. By Alden H. Miller. Pp. iii+169-194+plates 12-14. (Berkeley, Calif.: University of California Press.) 35 cents.

University o. California Publications in Zoology. Vol. 38, No. 3: Type Localities of Birds described from California. By Joseph Grinnell. Pp. 243-324. 1 dollar. Vol. 38, No. 4: New Pocket Gophers from Nevada. By E. Raymond Hall. Pp. 325-333. 25 cents. Vol. 38, No. 5: Three New Rodents from Lava Beds of Southern New Mexico. By Seth B. Benson. Pp. 335-344+plates 3-4. 25 cents. (Berkeley, Calif.: University of California Press.)

New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. 12 (Supplementary Part): Insects of Porto Rico and the Virgin Islands. Supplementary Report on the Heterocera or Moths of Porto Rico. By W. T. M. Forbes. Pp. 56+6 plates. (New York City.)

Field Museum of Natural History. Zoological Series, Vol. 18, No. 7: Reptiles and Amphibians of the Mandel Venezuelan Expedition. By Karl P. Schmidt. (Publication 309.) Pp. 157-163. 25 cents. Zoological Series, Vol. 18, No. 8: Notes on New Guinean Crocodiles. By Karl P. Schmidt. (Results of the Crane Pacific Expedition.) (Publication 310.) Pp. 165-172+plates 6-7. 25 cents. Zoological Series, Vol. 19: The Birds of Chile. By Charles E. Hellmayr. (Publication 308.) Pp. 472. 2.50 dollars. (Chicago.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 366-367: Hyperfine Structure of Mercury, V., by Kiyoshi Murakawa; Hyperfine Structure of Lead, by Kiyoshi Murakawa. Pp. 177-204. 30 sen. Nos. 368-369: Forest Fires and Weathers, by Torahiko Tereda and Tyokurô Utigasaki; *Diffraction of Cathode Rays by Single Crystals*, Part 1: P-Patterns, by Ken'ichi Shinohara. Pp. 205-236+plates 4-9. 45 sen. (Tôkyô: Iwanami Shoten.)

Smithsonian Institution: United States National Museum. Bulletin 162: Life Histories of North American Gallinaceous Birds, Orders Galliformes and Columbiformes. By Arthur Cleveland Bent. Pp. xi+490+93 plates. (Washington, D.C.: Government Printing Office.) 1 dollar.

Rubber Research Institute of Malaya. Annual Report, 1931. Pp. 7... (Kuala Lumpur.) 1 dollar.

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 636-D: Quality of Water of the Colorado River in 1926-1930. By C. S. Howard. (Contributions to the Hydrology of the United States, 1931.) Pp. ii+145-162. Water-Supply Paper 683: Surface Water Supply of the United States, 1929. Part 3: Ohio River Basin. Pp. viii+272. Water-Supply Paper 692: Surface Water Supply of the United States, 1929. Part 12: North Pacific Slope Drainage Basins. A: Pacific Slope Basins in Washington and Upper Columbia River Basin. Pp. vii+190. 25 cents. Water-Supply Paper 696: Surface Water Supply of the United States, 1930. Part 1: North Atlantic Slope Drainage Basins. Pp. viii+280. Water-Supply Paper 701: Surface Water Supply of the United States, 1930. Part 6: Missouri River Basin. Pp. ix+302. 50 cents. Water-Supply Paper 702: Surface Water Supply of the United States, 1930. Part 7: Lower Mississippi River Basin. Pp. v+115. 20 cents. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Geological Survey. Bulletin 833: Mineralogy of Drill Cores from the Potash Field of New Mexico and Texas. By Waldemar T. Schaller and Edward P. Henderson. Pp. viii+124+39 plates. 60 cents. Bulletin 838: Nitrate Deposits of the United States. By G. R. Mansfield and Leona Boardman. Pp. vi+107+11 plates. 40 cents. (Washington, D.C.: Government Printing Office.)

CATALOGUES

Catalogue of B.D.H. Fine Chemical Products: including Organic and Inorganic Chemicals, Analytical Reagents, Indicators, Standard Stains. (July, 1932.) Pp. 151. (London: The British Drug Houses, Ltd.)

Telcon Metals: Induction Melted Electrical Resistance Alloys in Rod, Wire and Tapes. Pp. 16. (London: Wild-Barfield Electric Furnaces, Ltd.)

SATURDAY, JULY 30, 1932

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Economic Problems of Native Communities

THE East African group of British colonies and dependencies has, during the last few years, had to endure a series of Government commissions, all undertaken with great pains and conducted by able chairmen. One of their main objects has been to determine the course of the political evolution of these regions, and the net results have been alternately to excite and depress the political aspirations of the resident European and Asiatic community, but the reflex effect on the more sophisticated section of the overwhelming black population cannot have been to its advantage.

The commissions culminated in a prolonged inquiry carried out by a Joint Committee of both Houses of Parliament sitting in London and presided over by the late Lord Stanley of Alderley, and after his lamented death, by Lord Onslow. This was a momentous business; it went on for some months and issued a monumental and well-balanced report. But inquiry was not yet to cease, for arising out of this Joint Committee is the report by Lord Moyne which is now before us; * one on railway economics, one on the financial position of Tanganyika Territory, and the Morris-Carter Land Commission are yet to come as sequelæ of the Joint Committee.

After the considerable expenditure of public funds involved by these extensive inquiries, it was pleasing to hear the Secretary of State for the Colonies recently declare, at the annual East African dinner, that inquiry had been overdone and would henceforth cease. Lord Moyne's report is, however, an admirable document; it is short, and it goes to the heart of things, namely, the economic position of the Colony. The old country, the heart of reserves of centuries of capital accumulation, has been shaken to its foundations during the last two years; the marvel therefore is that the colonies, all dependent on the production of raw materials which have slumped below cost of production, can have survived at all.

The main objects of Lord Moyne's inquiry were to ascertain the contribution made to taxation by the different racial communities, to review railway freights and import duties, and thus discover the extent to which each community in the colony benefits or suffers. Further, to ascertain as nearly as possible the amount of public money expended on natives and non-natives, and to what extent financial responsibility should be conferred on

* Report by the Financial Commissioner (Lord Moyne) on Certain Questions in Kenya. (Cmd. 4093.) Pp. vi+122. (London: H.M. Stationery Office, 1932.) 2s.

Native Councils. Lastly, to consider the general and economic situation in Kenya.

Lord Moyne approached his inquiry in an unbiased fashion, and conducted his mission with great rapidity; he has produced a document which it is impossible to controvert, and which should do much to dissipate a cloud of misinformation which has of late tended to obscure the situation.

Lord Moyne deals in detail with the incidence of the Hut and Poll Tax, which has up to now been the somewhat rough-and-ready way by which the native population of the country has made its contribution to the revenue. He puts his finger on the weak points of this system, and demonstrates how increasingly difficult it has become, particularly in some of the more remote districts, for natives to obtain the cash since the great slump in the values of produce occurred. He goes on to demonstrate how this fall in values has crippled the purchasing power of the natives, and so trade, generally, has greatly declined. The inequality, the inelasticity of this form of taxation, its lack of relation to prices of raw material, produced a considerable impression upon his financial mind, and he, moreover, pertinently remarks that "natives pay their tax not out of a fixed income but by means of additional production in the Reserves or alternately they may choose to earn the money by work in settled areas". For these reserves Lord Moyne recommends that the hut tax should eventually be replaced by a cultivation tax, that the poll tax should be a fixed sum, and in addition, there should be a live stock tax. There is much to be said for these proposals, but he does not appear to have considered fully the great increase of fiscal machinery these changes will involve when dealing with vast numbers of small cultivated plots. He next analyses the railway rates policy, and comes to the conclusion that their incidence is generally fair as between the racial communities. The same conclusion is also arrived at with regard to the incidence of import duties.

Perhaps the most difficult part of Lord Moyne's survey was the attempt to assess the amount of money expended in the interests of each community; and the impossibility of carrying out this aim with a great degree of accuracy is freely acknowledged. It is pointed out that the costs of various services, such as, for example, military and police, must be shown under general heads, for they benefit all communities. The plan of making two arbitrary divisions was thus adopted, namely, divisible and indivisible services. Even when this has been done, contrasts between racial standards of life make the measure of equality of sacrifice in taxation even more difficult of assessment. Lord Moyne frankly admits that he has formed the opinion that "in the development of the undivided services in Kenya there has been a bias towards the conveniences of a civilisation in which the native so far shares little of the direct advantages". But he goes on to make it clear that there is no suggestion that the European community has taken unfair advantage of their opportunity; it was, however, only to be expected when on one side we find a well-organised, politically-minded body of Europeans and on the other a mass of Africans only faintly articulate and with a weak representation on the Legislative Council. But after considering every factor in the case, as Lord Moyne realises, it is not even then easy to assess a fair proportion of expenditure for each section.

In 1931 each European contributed nearly £29 to the revenue of the Colony and each native contributed 5 shillings; the individual gap is immense. The aggregate contributed by some 17,285 Europeans is £665,780 and that contributed by some 2,950,000 natives is £791,100, and the amount spent directly on the European community is about £171,250 and on the African £332,000. The difficulty of comparison is due to the fact that the bare standard of service necessary for Europeans can bear little relation to that necessary for Africans.

The greatest problem at present in all African countries is to raise the culture level of the native; it was rising slowly up to the occurrence of the world-wide depression, and was mainly due to the progress of the activities resultant on white settlement; and when prices rally this progress will be resumed. A rise in the culture stage of the native, however, cannot be delayed, and it is essential to educate him to the widest extent in the practical art of life, so that he may obtain a better yield from his land and conserve and improve its agricultural value, instead of ruining it as he is doing at present. If this can be achieved, we shall fully justify our presence in Africa. At the same time, with the progress of the prosperity of the village the native cannot fail to develop sociologically. The African to-day is avid for education, but too often confines himself to a desire to read and write.

In order to ensure a definite provision for steady progress in education, agricultural training, and medical hygiene, we find the recommendation that one-half of the revenue obtained from native direct taxation should be placed each year in what is termed a Native Betterment Fund, to be adminis-

tered by a special committee, with which natives are to be closely associated, and also representatives of the European colonists. This, if carried into effect, is a proposal which will be welcomed by native opinion and do much to demonstrate the solicitude of Government to give the natives a fair deal. The Kenya politicians may, however, plead that it is unconstitutional, as it will operate independently of the Legislative Council.

The proposal to found a Native Marketing Advisory Council is also one that is long overdue, for the victimisation of natives by Asiatic traders has for years past been a matter of concern.

Space forbids reference to many points of interest, but it is evident that, quite apart from its special reference to one Colony, Lord Moyne's report carries many lessons which are applicable to other dependencies of a similar class, for it demonstrates the importance of far-sighted discrimination in regard to local financial demands, and the necessity of firmer control than that which successive governors have, owing to political exigencies, been able to exercise in the past. C. W. H.

Recovery: A Scientific Programme

Recovery: the Second Effort. By Sir Arthur Salter. Pp. xvi + 306. (London: G. Bell and Sons, Ltd., 1932.) 10*s.* 6*d.* net.

THERE could be few more startling contrasts than that between the pedantic platitudes of the naval and military experts of the Disarmament Conference, their endless splitting of hairs, and the balanced and comprehensive survey of the events during the last thirteen years that have been mainly responsible for the present critical world position which Sir Arthur Salter gives us in his book "Recovery". Alike in his analysis and summing up of the various special problems of currency, finance, reparations and war debts, tariffs, industrial organisation, Government control and security, on which his experience as a high official of the League of Nations, as first general secretary to the Reparations Commission, and active participant in most of the international negotiations and acts in the first effort at post-war recovery render him an expert authority of the highest standing, Sir Arthur writes with a vision and a sense of values which only emphasises the narrow-mindedness and inadequacy of the military and naval experts. We have been accustomed in Britain to admit such experts to positions of high administration and authority from which the scientific expert is rigidly excluded. When allowance has been made for Government pressure or for the absence of adequate instruction or definite policy from the Conference itself, the proceedings of the experts at the Disarmament Conference make a dismal record which may well endanger the future use of the expert in administration, in spite of the striking success which under appropriate conditions has attended the work of the expert committees of the League in health, finance, economics, transit and communications, etc.

The masterly diagnosis which Sir Arthur gives us of the causes of the world depression conveys the emphatic impression that the main cause of our present critical position is not monetary, economic, or political, but the persistent attempt to handle world problems on national and sectional lines—the same effort which, unless public opinion realises the danger in time, threatens to defeat the purpose of the Disarmament Conference. The whole book is an antidote to such small-mindedness. Writing with an essentially scientific outlook, Sir Arthur conveys not only a sense of perspective in viewing the complex reactions of the financial, industrial, economic, and political factors involved in the field of monetary policy, credit, commercial policy, economic organisation, government, and peace, but also gives us trenchant and constructive criticism which leads him to prescriptions for recovery and for a 'New World Order' set out in his concluding chapter.

To this chapter the majority of readers will turn most eagerly, and it should accordingly be noted that Sir Arthur reaches his conclusions as a result of impartial analysis of the relevant factors and a determined attempt to disentangle them from prejudice. Only in this way can we arrive at a satisfactory basis for adequate action, and this method of procedure will at once be recognised as fundamentally that of science.

Characteristic of the book is its note of confidence. Difficult as is our task, the problem facing us is, as Sir Arthur rightly reminds us, capable of human solution. "Never was Nature so prodigal in her gifts; never was man so well equipped in skill and scientific resources to utilise them." Or again, "We are, if we could but grapple with our fate, the most fortunate of the generations of men. In a single lifetime science has given us more power over Nature, and extended further the range of vision of the exploring mind, than in all recorded history. Now, and now only, our material resources, technical knowledge, and industrial skill are enough to afford to every man of the world's teeming population comfort, adequate

leisure, and access to everything in our rich heritage of civilisation that he has the personal quality to enjoy." This is the spirit in which the triumphs of science and of statesmanship alike have been achieved, and the book was worth reading if only for the reminder it gives us that by bringing to our task courage and magnanimity we shall assuredly find the wisdom to control our specialised activities and the waywardness of our sectional and selfish interests. The difficulties and problems created by defects in human organisation, planning, and direction, or from weakness in our financial and distributive systems, are essentially remediable evils and removable causes, requiring only for their elimination an effort of searching analysis and constructive reform in our western world comparable in boldness and determination with that which is now being witnessed in Russia, with however different a goal or method.

It is in this spirit that Sir Arthur is led to his constructive proposals. Accordingly, he sees the need for central institutions to put the credit and borrowing capacity of selected classes of those needing capital on the soundest foundation. Such institutions would be able to secure, far more economically and efficiently, the necessary experts to examine the technical merits of any proposed scheme. Suitable mechanism is also required to secure that any political factors involved should be examined by some agency of the League of Nations, to prevent any repetition of the discreditable borrowings of 1926–28, with their dangers to world peace.

Discussing commercial policy and tariffs, Sir Arthur Salter points out the fallacy of most of the so-called scientific tariffs and the way in which they tend to direct energy and attention from the improvement of industrial efficiency to the corruption of governments. The only scientific tariff, in Sir Arthur's view, is that offered temporarily and conditionally by a strong and competent government to stimulate and assist reorganisation of an industry. This authoritative comment indicates the wisdom of the policy advocated by Capt. Macmillan in regard to the functions of the Tariff Commission, and is an emphatic warning of the dangers attending the unregulated introduction of a tariff system. The dislocation and gradual stoppage of international trade is a danger to the world second only to the menace of world peace which the consequent disintegration into separate units and groups presents.

Part of the support for a tariff policy in Britain has come from those who recognise the need for a more deliberate and collective planning of our economic life; and the existence of such support, which is likely to be conditional on an increasingly better planning for real public and social benefit, constitutes some hope of reform. For similar reasons, Sir Arthur, while frankly recognising certain dangers inherent in the growth of large industrial organisations, sees in them the means of securing the necessary planning of supply over the whole range of an industry, and so securing stabilisation as no national agreement could do except behind prohibitive tariffs. International agreements and cartels and National Economic Councils can in fact constitute a basis upon which a World Economic Council could effectively discuss, upon a world range, questions of finance and control of output, resulting in definite industrial planning through the world, and in addition, by cutting across national frontiers, they create interests and forces which will tend to counteract the competitive nationalism which is the world's chief danger.

These National Economic Councils are themselves a significant development of the last decade, and although at present largely experimental, may ultimately prove of great value in the machinery of government, which almost everywhere is now proving inadequate to the tasks which it has assumed. Sir Arthur's natural sympathy with *laissez faire* emphasises the policy of economic planning and radical reconstruction to which he is driven by facts and not by inclination. Only by such a policy can he see the mechanism of central direction and restraint sufficiently strengthened to control the specialised activities of men and the individual energy whether of persons or organised sections which threatens to destroy and not extend the common weal. Delegation of national government authority along such lines, drawing into the public service the great private institutions which represent the organised activities of the country, including chambers of commerce, banking institutions, industrial, professional, and labour organisations, and simultaneously the integration of the national organisation thus developed into an organ of world policy through the League of Nations, is the way in which Sir Arthur visualises government as becoming once more equal to its task. The whole framework, first and last, is based upon peace, upon the firm establishment of the collective system in the confidence of the world, until in the new world order the causes from which wars originate are eliminated.

Here is a programme worthy of earnest consideration by scientific workers individually and

through their professional and industrial organisations. Sir Arthur Salter has given us as it were a world map on which the broad lines of advance, the practical routes, are plainly marked. The details have yet to be filled in if mankind is to advance towards recovery, and that advance depends not more on the contribution of statesmen than of scientific workers and other individual sections of the community. To that task of systematic and scientific exploration each must bring their contribution in a spirit of adventure, of courage, of magnanimity which, for the moment, so many in this apprehensive world seem to have abandoned.

Some Extinct Horned Mammals

Department of the Interior : U.S. Geological Survey. Monograph 55 : The Titanotheres of Ancient Wyoming, Dakota and Nebraska. By Henry Fairfield Osborn. Vol. 1. Pp. xxiv + 701 + plates 1-42. Vol. 2. Pp. xi + 703-953 + plates 43-236. (Washington, D.C.: Government Printing Office, 1929.) 9 dollars.

THE Titanotheres are a group of odd-toed hoofed mammals which lived during the early part of the Tertiary epoch about the fortieth parallel of latitude in North America and Asia, and occasionally strayed into eastern Europe. They are peculiar in their low-crowned molar teeth, which never became sufficiently deepened to be useful for feeding on dry vegetation. They are also unique among odd-toed hoofed mammals in having the forefoot almost like that of the even-toed hippopotamus, with only a slight tendency towards the greatest weight on the third toe. So far as known, they first appeared at the end of the Lower Eocene period, when they were small hornless dwellers in swamps, evidently feeding on succulent vegetation. They became extinct at the end of the Lower Oligocene period, when most of them had grown to be as large as rhinoceroses or even as small elephants, adapted to live on hard ground, with prehensile lips for browsing, and with a pair of horns, supported by bony cores, on the top of the prominent nose. The fossil remains of these large forms were found first, and hence the name given to the group.

As the Titanotheres completed their evolution in so short a period of geological time, and as they are now represented in museums by the remains of very numerous individuals of many genera and species, they are of extreme interest to the palæontologist. They are also of value to the geologist as marking successive layers in the early Tertiary rocks where they happen to occur. Science is therefore much indebted to the United States Geological Survey and to Prof. Osborn for the two handsome volumes in which these extinct mammals are most exhaustively described and discussed from every point of view. The monograph was planned many years ago by the late Prof. O. C. Marsh, who supervised the drawing of numerous plates which are now reproduced and used as effective illustrations. Prof. Osborn, with the aid of his colleagues in the American Museum of Natural History, has been engaged on it since the beginning of the year 1900. The result is the most elaborate work ever devoted to a group of vertebrate fossils.

All the known genera and species are described in detail in systematic order, with full references to the literature of the subject, and beautiful drawings and outline sketches of the fossils on which they are founded. The systematic descriptions are then supplemented by a valuable chapter on the probable muscular anatomy of the Titanotheres by Prof. W. K. Gregory, who also discusses the mechanics of locomotion both in these mammals and in the other odd-toed families. The central feature of the monograph, therefore, is a well-arranged collection of facts, which will always remain available for reference, however much opinions may differ as to their interpretation.

Nearly half of the monograph is devoted to general questions and the interpretation of the facts, which have already been dealt with by Prof. Osborn in preliminary papers during the progress of the work. These chapters are a little difficult to appreciate, on account of the literary style, frequent repetitions, and lack of conciseness; but they bring together a remarkable mass of material for which both geologists and palæontologists will be grateful. The numerous diagrammatic illustrations are especially helpful.

One preliminary chapter gives an elaborate account of the various American Eocene and Oligocene formations in which remains of Titanotheres occur, and concludes with a series of photographs of localities in which collections have been made. Another chapter discusses mammalian palæontology in general. Other chapters deal with various aspects of the evolution of the Titanotheres and their allies, and the possible ways in which they may have been exterminated at the time when they attained their maximum development and apparently maximum strength. It is especially interesting to notice that there seem to

have been several parallel groups all evolving in the same direction but at different rates—a phenomenon which is now becoming familiar to those who trace the distribution of extinct animals through successive geological formations.

When the monograph had been completed, the exploring party of the American Museum of Natural History in Mongolia made the first great collection of remains of Titanotheres from Asia. Prof. Osborn has therefore added a very interesting appendix on this discovery. It appears that most of the genera found in Asia are identical with those already recognised in North America, but they are represented by species which are about twice as large as those already met with in America. There is also a new genus, *Embolotherium*, comprising some of the largest Titanotheres known, in which the two immense horns are fused into a battering-ram. This animal was one of the latest members of the race, existing at the end of Lower Oligocene time; and when it became extinct, its place was taken in the Gobi region by the gigantic *Baluchitherium*, which belonged to the rhinoceros group.

Prof. Osborn's stimulating monograph, indeed, leads us to hope that it is only the first of a series which the United States Geological Survey will publish, when other groups of American fossil vertebrates have been studied in equal detail from our present point of view. A. S. W.

Domestic Science

(1) *Everyday Domestic Science and Hygiene.* By I. C. Joslin and P. M. Taylor. Pp. viii + 532. (London: Macmillan and Co., Ltd., 1932.) 6*s.*; Part 1, 3*s.*: Part 2, 3*s.* 6*d.*

(2) *Household Physics.* By Walter G. Whitman. (The Wiley Technical Series for Vocational and Industrial Schools.) Second edition, revised. Pp. vii + 502. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 16*s.* 6*d.* net.

(1) THE first of these books has been written with the object of providing a scientific foundation for a school course in household science and human physiology up to the standard of the General Schools Examination. The general plan of the book is excellent. The elements of physics and chemistry are first dealt with, and the pupils' interest in the subject is well maintained both by the experimental work and by the numerous examples showing the application of the principles to domestic work. A knowledge of food values is essential for the proper planning of meals, and the authors have shown their appreciation of this fact by their very thorough treatment of this section of the subject. The source, preparation, and methods of cooking of the chief substances used as foods are described and many experiments are given. A chapter on micro-organisms well emphasises the necessity for cleanliness in the preparation and storage of foods—a subject which in Great Britain has, up to the present time, received far too little attention. Human physiology, personal hygiene, and first-aid are treated so far as "they may be studied appropriately in a general science course for girls".

The authors do not give any indication of either the number of periods a week or the number of years required to complete the course satisfactorily. An examination of the book would indicate that three periods a week, one devoted to practical work and two to class work, for three years, would enable the work to be done in such a way as to secure the maximum value in educational training and a good knowledge of the subject. The book is one of the best dealing with this subject that has appeared in recent years; the sequence of practical work and class work is excellent, and the most recent developments are included. Among such may be mentioned the 'Regulo' device for controlling the temperature of the modern gas oven, the principles underlying the working of the household refrigerator, and the importance of vitamins in foods.

(2) The second of these books aims at presenting physics adapted for girls both in general and in home economics courses. The method is almost entirely instructional as distinct from educational, and every device used in the home, from electric lamps to 'talking picture' projection, and from carpet sweepers to twelve-cylinder motor cars, that depends in any way upon physics, is fully described. Most of the subjects are treated in far too great detail; for example, it is not necessary, for an intelligent understanding of the working of electric home appliances, to have a knowledge of magnetic fields around a solenoid or of the principles underlying the use of 'step-up' transformers. It is difficult to justify the inclusion of descriptions of such instruments as compound microscopes in a household physics course. The illustrations are numerous and excellent, and the subject matter is dealt with in a very interesting way. The book is one that would appeal to all mechanically minded boys, and would be a welcome addition to any boys' school library.

It will be noticed that though both the books have about the same number and size of pages and are equally well produced, the price of the first is 6*s.* and of the second 16*s.* 6*d.* J. H. S.

Short Reviews

(1) *Fortschritte der Biochemie.* Teil 2 (1924–1931). Von Prof. Dr. Felix Haurowitz. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 26.) Pp. x + 152. (Dresden und Leipzig: Theodor Steinkopff, 1932.) 11 gold marks.

(2) *Les problèmes de la biochimie moderne.* Par Prof. G. Florence et Dr. J. Enselme. Pp. 312. (Paris: G. Doin et Cie, 1932.) 45 francs.

(1) THIS small book is a comprehensive review of biochemical literature during the period 1924–1931; it is a continuation of Part I. (1914–1924). An index mentions 900 authors, and more than one thousand papers must have been referred to, so that little of importance has escaped. The size of the book has imposed considerable brevity (wave mechanics are treated in a single page); hence it is scarcely a continuation of older textbooks, as the preface seems to suggest, but rather a valuable guide to the recent literature, which every biochemist should possess. There is even a useful final section on methods. Robinson on p. 14 should be Robison, and on p. 28 we are referred to a formula on p. 00 which does not seem to have been included anywhere.

(2) The title suggests a resemblance to the preceding, but a study of the contents reveals considerable differences. The French authors include older work and often little that is recent. Thus the section on muscle metabolism does not extend beyond 1928, and seems actually based on the junior author's M.D. thesis of 1924; it is consequently completely out of date. The sections on hæmin and chlorophyll are likewise antiquated. The range is smaller than that of the German book, and even those topics which have been selected are often treated inadequately, for example, the sterols. The section on carbohydrates is among the more satisfactory. Sometimes there is considerable detail; thus the (old) method of preparing glutathion (still a dipeptide) is described at great length, and the mathematical theory of Svedberg's ultracentrifuge is included, so that the book has its occasional uses. It is marred by numerous misprints. There is not only disregard for the spelling of proper names (Lotter-Maser; Deloye and Scherrer in the text, Debye and Sherrer in the index); such mistakes are merely inartistic to foreign eyes, but when it comes to Year instead of Goodyear, and the page of the journal is also wrongly quoted, these mistakes become distinctly inconvenient. G. B.

Across the Gobi Desert. By Sven Hedin. Pp. xxii + 402 + 67 plates. (London: George Routledge and Sons, Ltd., 1931.) 25*s.* net.

THIS volume is the English edition of the account, originally published in Sweden, of Dr. Sven Hedin's great expedition to the Gobi Desert, or rather of the first stage, which in the winter of 1927–1928 brought him to Urumchi. The author considers this the greatest expedition of his life; and it was certainly a marvel of organisation and equipment. Unfortunately, it was impossible to carry out one part of the programme. At Urumchi the governor of the Province of Sikiang refused to allow the eight German airmen to fly over the inaccessible parts of the desert and they had to return home. In other branches of investigation, but especially in geology, geography, and archæology, the expedition has achieved some remarkable results, of which the scope is outlined in this book.

In the summer of 1928 Dr. Sven Hedin returned to Sweden to raise funds for the continuance of the work, and the expedition then became a joint Sino-Swedish undertaking with a staff of Chinese scientific workers and students collaborating with the European members. The author speaks in high terms of praise of his Chinese colleagues, both in regard to their scientific work for the expedition and in reference to his personal relations with them. Although it may be inferred that there have been difficulties in his dealings with the Chinese, Dr. Sven Hedin has no criticisms to offer; and indeed in so far as he might be cited as a witness on the question of friction between Europeans and the Chinese authorities, he would seem to suggest that in some cases at least the Europeans rather than the Chinese are to blame. He is, of course, referring only to matters in which the interests of science are affected.

The interval which has elapsed before the publication of the English edition of his book has enabled the author to add chapters dealing with the discoveries which have confirmed the fact of the diversion of Lop Nor Lake to its ancient bed after five hundred years, and to give its exact position as determined by members of the expedition in April 1931.

An Introduction to the Mathematics of Map Projections. By R. K. Melluish. Pp. viii + 145. (Cambridge: At the University Press, 1931.) 8*s.* 6*d.* net.

THIS book, in the earlier chapters, traces the history of projection, and presents an account of the general theory, together with deductions. Then follows a chapter on the theory of the indicatrix and the method of comparing one projection with another; next the question of finite measurements and the errors of finite representation. The last chapter is concerned with the selection, from mathematical considerations, of the best projection for a given country. The work is both useful and interesting, although not a complete treatment, even on the mathematical aspect of this subject. The title must not be taken to mean that the mathematics are therein explained. The reader will soon discover that it is assumed he has a fair knowledge of calculus to enable him to work out many details. The author has made no concessions to weaker mathematicians.

The book is "the outcome of a mathematical essay on maps written at Cambridge in 1922". The author was later influenced by Mr. A. R. Hinks, and by the late Mr. A. E. Young's work on the "Minimum Error".

In view of the interest which has recently been manifested in this subject of map projections, it is fortunate that a book dealing "comprehensively with the theories that underlie their construction" should have appeared. To the geographer with a mathematical bias this carefully prepared book will be especially welcome. J. E. C.

Properties and Mechanics of Materials. By Prof. P. G. Laurson and Prof. W. J. Cox. Pp. x + 353. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 17*s.* 6*d.* net.

Written for students of American universities and based on American standards and specifications, this book, within these limitations, constitutes a useful introduction to the subject, in that it combines an account of the stresses to which materials are subjected in constructional work with the description of the materials themselves. It is mainly of the nature of a preliminary survey, with the emphasis properly laid on fundamental principles, which it is desirable that the student should grasp thoroughly before allowing his attention to be diverted to specialised problems. The English engineering student will find in it a number of terms, units, and methods with which he may not be altogether familiar, but it will be useful to him in widening the range of his knowledge and giving him an insight into trans-Atlantic standards and practice. At the same time, the references to the conditions governing such characteristic American structures as the multi-story building, or 'sky-scraper', are by no means prominent, and one looks in vain for information on the subject of foundations. There is a list of references for further reading, but it is entirely American; no British or European standard books are quoted. B. C.

Hydraulics: a Textbook covering the Syllabuses of the B.Sc. (Eng.), A.M.Inst.C.E. and A.M.I.Mech.E. Examinations in this Subject. By E. H. Lewitt. (Pitman's Engineering Degree Series.) Fourth edition. Pp. xii + 372. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) 10*s.* 6*d.* net.

This is a textbook which has been compiled for the specific purpose of covering the examination syllabuses of certain universities and professional bodies. It is, therefore, somewhat narrow and rigid in its treatment of the subject, but that it is popular with engineering students is evident from the fact that the work is now in its fourth edition. Indeed, as an examination textbook, it is admirably clear and concise. But as a general review of the subject it is, perhaps unavoidably, a little lacking in breadth. The chapter on flow through open channels, for example, gives the Chezy formula with Bazin's values for the coefficient, but takes no note of the elaborate, and more generally recognised, expressions of Ganguillet and Kutter, or those of Hazen and Williams, Manning, Barnes, and others. The present edition of the book has been enlarged to include new material on the viscous resistance of a fluid, and the sections on hydraulic machines have been considerably amplified. On page 174, the author is mistaken in attributing to the late Lord Kelvin the explanation of scouring at river bends: it is to his brother, the late Prof. James Thomson, that the credit is due. B. C.

(1) *Operational Methods in Mathematical Physics.* By Dr. Harold Jeffreys. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 23.) Second edition. Pp. viii + 119. (Cambridge: At the University Press, 1931.) 6*s.* 6*d.* net.
(2) *Cartesian Tensors.* By Dr. Harold Jeffreys. Pp. vii + 93. (Cambridge: At the University Press, 1931.) 5*s.* net.

(1) A new edition of this really useful book is to be welcomed. The author has returned to Heaviside's notation of p for the operator, a distinct improvement. The chapter on Bessel functions has been rewritten and illustrated with reference to submarine cable telegraphy.

(2) While vector algebra demands the learning of a new notation, the tensor method is only a concise way of writing a notation which is already familiar. Special simplifications are introduced by the use of rectangular Cartesian co-ordinates, and tensor algebra is then a simple and useful tool for obtaining general theorems in a concise manner. In this excellent little book the notation is explained and illustrated by applications to geometry, dynamics, elasticity, and hydrodynamics.

The Archæology of Cornwall and Scilly. By Dr. H. O'Neill Hencken. (The County Archæologies.) Pp. xvii + 340 + 12 plates. (London: Methuen and Co., Ltd., 1932.) 10*s.* 6*d.* net.

Dr. Hencken's volume on Cornwall and Scilly, while following the plan of the series, is somewhat broader in its method of treatment. For this, the material is in part responsible. It was inevitable that such topics as the Cornish megalithic monuments and the burial chambers of Scilly, the position of Cornwall in prehistoric trade, its tin mining industry, and the relation of its legendary history to its archæology after the Roman evacuation should call for discussion on broad comparative lines. As a result, the book, while no less valuable to the archæologist than its predecessors, is even more attractive to the general reader.

Zoologie biologique. Par Prof. Étienne Rabaud. Fascicule 1: *Morphologie générale et système nerveux.* Pp. xxi + 223. (Paris: Gauthier-Villars et Cie, 1932.) 45 francs.

This is the first of three volumes which deal respectively with general morphology in relation to the nervous system, nutrition, and reproduction. The first volume approaches the problem of general morphology by describing the fundamental structure of all animal forms in terms of the integument, organs of locomotion, and the body cavities.

The relation of the organism to the environment is approached by the study of the peripheral nervous system, with special attention to the nerve endings of ordinary and special sensation. The author has succeeded in introducing many of the conceptions of modern physiology into morphology.

Theories of Hearing*

By Prof. H. HARTRIDGE, F.R.S.

RIVALRY still exists between the theories of hearing, because the small size, the delicacy, and the inaccessibility of the internal ear make direct observation and experimentation wellnigh impossible. Among the rival theories are the telephone theory, the modified telephone theory of Boring, the modified telephone theory of Watt, the volley theory of Wever and Bray, the pattern theory of Ewald, the stationary wave theory, and the resonance theory. At the present day, controversy principally centres round the resonance theory and some form of telephone theory.

THE TELEPHONE THEORY

According to the telephone theory, the ear behaves like a microphone. Variations of air pressure in the ears, at the frequencies of sound emitted by the source, are followed by the passage of impulses up the auditory nerve fibres to the brain. Like the electric currents in a telephone wire, these nerve impulses are controlled by the frequencies, intensities, and the phases of the incoming sound waves. The temporal lobe of the brain, on receiving these nerve impulses, interprets suitably the changes in pitch and quality which are heard, and assigns them to the musical instruments which are being employed.

The telephone theory encounters the following difficulty: experiment shows that the ear can hear frequencies up to about 15,000 vibrations per second. A telephone circuit transmitting these high frequencies would undergo 15,000 fluctuations in voltage per second. The ear, if it were behaving like a telephone, should therefore send up the fibres of the auditory nerve 15,000 impulses per second. But experiment shows that the highest frequency at which mammalian nerve fibres can transmit impulses is about 1000 per second. A modification of the telephone theory, called 'the volley' theory, meets this difficulty by assuming that a suitable co-ordinating mechanism exists in the internal ear. By means of this mechanism the auditory nerve fibres are divided into groups and each group in turn is called on to transmit an impulse. If there were 15 such groups, a frequency of 15,000 vibrations per second could be conveyed to the brain by nerve fibres which individually can only convey 1000 vibrations per second.

THE RESONANCE THEORY

According to the resonance theory, the ear contains a number of tuned structures, the natural periods of vibration of which correspond to the range of audible frequencies. Separate nerve fibres connect the sensory organs on these 'resonators' with different parts of the temporal lobe of the brain. In consequence, when sounds of one frequency are received, and one group of resonators vibrates, the sense organs of these resonators are stimulated and their nerve fibres convey impulses to one part of the temporal lobe. Sound waves of other frequencies will cause different groups of resonators to vibrate, and different parts of the temporal lobe will thus receive nerve impulses.

The resonance theory encounters the following difficulty: the vibrating structures in the ear have lengths of roughly half a millimetre, and the lowest audible frequency is approximately 20 vibrations per second. It is at first sight difficult to see how it is possible for such very short structures to perform vibrations in resonance to such low frequencies.

The formula for the fundamental frequency of vibration of a stretched string is as follows:

$$\text{frequency} = \frac{1}{2\ \text{length}} \times \sqrt{\frac{\text{tension}}{\text{mass per unit length}}}.$$

If, therefore, tension is suitably decreased at the same time as length, then frequency remains the same. It is therefore possible to have a fibre 0·5 mm. in length possessing a natural frequency of 20 vibrations per second, provided that the tension has a suitable value. The vibrating structures of the ear satisfy the required conditions.

EXPERIMENTAL EVIDENCE IN FAVOUR OF RESONANCE

Much experimental work has accumulated during the last few years which is in favour of the resonance hypothesis and against the telephone hypothesis.

(1) When by surgical interference a limited part of the internal ear is damaged, not only does deafness over a narrow range of frequencies result, but also the frequencies concerned correspond with the part of the internal ear which has been damaged. That is to say, if the damaged fibres are short, then high notes are involved; if, on the other hand, the damaged fibres are long, then low notes are involved.

(2) Boilermakers, in course of time, acquire deafness to high notes. Microscopic examination after death shows that the short fibres of the internal ear have been pathologically affected. Also, when animals are subjected for considerable periods of time to loud sustained musical tones, they become deaf to the musical tone to which they have been subjected. A microscopic examination of their internal ears after death shows that the fibres affected correspond approximately in length to the frequency of the tone to which the experimental deafness has been produced.

(3) When a musical tone, transmitted by a telephone circuit, is suddenly changed in phase by a half-cycle, the voltage fluctuations in the circuit continue almost without interruption.

When a musical tone, which is causing a tuned structure to perform resonant vibrations, is suddenly changed in phase by a half-cycle, the

* Friday evening discourse at the Royal Institution, delivered on April 29.

vibrations of the tuned structure are first arrested and are then re-established. On performing a similar experiment with the human ear, just after the change of phase the musical note is heard to undergo a short interruption, that is, the ear behaves as if it contained resonators, and unlike a telephone.

(4) When a musical tone is interrupted for short periods of time, similar interruptions can be identified in a telephone circuit which is excited by the sound. When a musical tone, which is causing a tuned structure to perform resonant vibrations, is interrupted for a short period of time, the vibrations of the tuned circuit are found to continue with only a small diminution in amplitude. On performing a similar experiment with the ear, it is found that short interruptions cannot be detected; hence the ear behaves as if it contained resonators, and unlike a telephone.

(5) When two musical tones differing considerably in frequency, for example, 200 v. per sec. and 250 v. per sec., are sounded simultaneously into a telephone, the voltage fluctuations in its circuit are found to correspond to a single frequency of 225 v. per sec. with periodic increases and decreases of amplitude (beats) occurring 50 times a second. When the above two tones are caused to set up vibrations in a graduated series of resonators, two separate groups of resonators are found to be set into vibration, one corresponding to 200 v. per sec., the other corresponding to 250 v. per sec. A careful examination of the groups shows that neither of them is exhibiting appreciable beats. On performing the experiments with the ear, the two separate tones of 200 v. per sec. and 250 v. per sec. are heard and no beats are to be observed; hence the ear behaves as if it contained resonators, and unlike a telephone.

(6) When two musical tones having frequencies in the ratio of 1 to 3 are sounded simultaneously, the voltage fluctuations in a telephone circuit excited by them are found to be greatly affected by the relative phases between the two tones. In one phase relationship a single sharp peak curve is produced. In another phase relationship a double hump curve is produced. When the above two tones are caused to set up vibrations in a graduated series of resonators, two groups of resonators are found to be set into vibration, one group for each tone. The careful examination of the groups shows that neither their frequency nor amplitude is affected appreciably by changing the relative phases of the two tones. On performing the experiment with the ear, it is found that changing the relative phases of the tones has no effect on the sounds which are produced; that is, the ear behaves in accordance with the resonance theory and contrary to the telephone theory.

(7) It is well known that resonators exhibit the properties of selectivity (sharpness of resonance) and persistence, and that both these properties are related to the frictional losses to which the resonators are subject. In consequence of this, when different degrees of selectivity are multiplied by corresponding degrees of persistence a constant value is obtained, as is shown in the following table:

S (selectivity).	P (persistence).	$S \times P$.
1·5	40	60
2·0	30	60
3·0	20	60
4·0	15	60
6·0	10	60

(Selectivity in the above table is the percentage difference of frequency causing one-tenth the amplitude of that caused by the intune frequency at the same energy level. Persistence is the number of vibrations which correspond to the time required for the amplitude to be reduced to one-tenth its initial value.)

Now, the selectivity of a graduated series of resonators can be ascertained experimentally by finding the smallest difference of frequency which causes beats owing to the overlap of the two vibrating groups of resonators. The persistence of a series of resonators can be ascertained experimentally by finding the duration of the longest interruption in the incoming sound energy which produces no observable decrease in amplitude. Both these methods of research are applicable to the ear, and the table below gives the values I obtained. The last column shows that their product gives a reasonably constant value, as should be the case if the ear resonators are of the kind familiar to the physicist.

Tone.	S.	P.	$S \times P$.
128	12·7	1·78	22·6
256	10·0	2·06	20·6
326	9·45	2·19	20·7
384	9·07	2·18	19·75
512	8·45	2·37	20·0
640	8·15	2·54	20·65
760	7·82	2·68	20·95
1024	7·22	3·01	21·70

REPLIES TO OBJECTIONS TO THE RESONANCE THEORY

(1) In a piano the wires are all separated from one another and are therefore free to vibrate individually. It is not difficult therefore to picture a small group of wires, or even a single wire, being set into resonant vibration. In the internal ear, on the other hand, the resonating fibres are seen under the microscope to be attached sideways to one another. How is it that these attachments do not impede or even stop resonant vibrations, or at the very least produce an irregular jangling?

In replying to this question, two points require emphasis; first, that when a group of resonators is being set into vibration by incoming sounds, those above and those below the frequency of the resonator which is strictly in tune with that of the sound are performing what are aptly called 'forced vibrations'. They do not perform vibrations at their own natural frequency, but vibrate at the frequency of the incoming sound energy. Thus, suppose a group of wires of a piano to be set into resonant vibration by a strong source having a frequency of 200 vibrations per second. Then, a stroboscopic examination of the vibrating wires should show that those on one side of the intune resonator are all moving towards or away from the observer at the same time.

Secondly, the number of fibres of the internal ear set into forced vibration by a pure source of sound is much more numerous than is usually supposed. If, having ascertained the fibre strictly 'in tune' with the musical tone, we count sixty fibres above it in pitch, on examining this fibre we should find *that it is performing vibrations* with an amplitude which is approximately one-tenth the amplitude of the 'intune' fibre. The sixtieth fibre below the intune one is also performing vibrations with an amplitude of one-tenth the intune one. Since so many fibres are affected, the difference in amplitude between one fibre and its next-door neighbours is very small; calculations show that they nowhere exceed 5 or 6 per cent. The attachments of the fibres to one another should therefore not markedly impede their vibration, and are therefore not incompatible with the resonance theory.

(2) So long as the incoming vibrational energy continues, resonators continue to vibrate; when this energy ceases, they gradually come to rest in an exponential manner. If the ear contained resonators, on the cessation of a musical tone we ought to be able to hear a gradual diminution of loudness. Everyday experience shows us, however, that silence appears to follow the cessation of musical tones almost immediately, and this is incompatible with the resonance theory. The explanation of this objection is as follows: If we know the threshold of stimulation of the sense organs attached to the fibres in the internal ear, and if we know the degree of persistence of the ear, we can readily calculate the time taken for the vibrations of the fibres to be reduced until 'silence' is reached. The values thus obtained for notes of medium loudness are given in the following table:

Tone.	Time in Seconds for Termination of Hearing.
128	0·057
256	0·036
512	0·021
1024	0·012

We see that these times are very short. Even for a tone of 128 vibrations a second, the time of the termination of hearing is less than one-seventeenth of a second. Our experiences, therefore, are not incompatible with the resonance theory.

(3) Pathological changes in the internal ear are sometimes found to produce deafness to one or more groups of frequencies. Whereas most tones, both high and low, are heard in a normal manner, there is deafness to certain intermediate ranges of frequency. It is often found that a frequency inside this range can be correctly perceived if its intensity be much increased. This finding is held to be incompatible to the resonance theory, on the following grounds: Suppose a certain number of fibres of the internal ear to be destroyed, then it is clear that the ear will be deaf to tones corresponding in frequency to the damaged fibres. If now a tone of sufficient intensity be sounded, which corresponds in frequency to the centre of the damaged region, normal fibres at the edges of the deaf region should be caused to perform vibrations. Provided that the stimulating tone be loud enough, the forced vibrations should have sufficient amplitude to stimulate their respective sensory end organs. The individual should now hear one or more musical tones which correspond to the frequencies of these normal fibres. But experiment shows that what he does hear is a tone which corresponds to the frequency of the tone which is being sounded.

An example may make matters clearer. Suppose a man to be deaf to frequencies of from 200 to 240 vibrations per second, owing to complete destruction of the fibres which correspond to this region. Then on sounding a tone of 220 vibrations a second of ordinary intensity, nothing is heard by the affected ear. On sufficiently increasing the intensity of the sound, however, there should be, according to the resonance theory, forced vibrations on the part of the normal fibres just below 200 vibrations per second and just above 240 vibrations per second, and therefore the individual should hear two musical tones corresponding to these frequencies. Experiment shows, however, that what he does hear is a single musical tone corresponding to 200 vibrations per second, a result which, it is claimed, is incompatible with the resonance theory.

The reply to this objection is that its supposed pathological basis is unsound. Regions of deafness are not due to clean-cut destruction of certain fibres leaving neighbouring fibres intact, but rather to localised adhesions and exudates interfering with the normal vibrations of the fibres. In consequence, a tone of normal intensity sets the affected fibres into such feeble vibration that their sense organs receive insufficient stimulation. A more intense tone, on the other hand, may cause sufficient amplitude of vibration for the stimulating tone to be recognised. The behaviour of an individual with islands of deafness is not, therefore, incompatible with the resonance theory.

(4) It is found by experiment that a dog in which a limited number of fibres of the internal ear has been destroyed by a drill, exhibits afterwards deafness to a very small range of frequencies. Now, according to the resonance theory, many fibres are affected by a single frequency, and therefore deafness to a considerable range of frequencies should occur. Since this is not found to be the case, this experimental result is claimed to be incompatible with the resonance theory.

The reply to this objection is as follows: Suppose the part of the internal ear affected by the drill to be one millimetre in width. Then it is found by calculation that approximately 350 fibres would be destroyed. Now, we have evidence that one musical tone affects approximately 200 fibres, so that it is clear that the deaf region would correspond to the difference between these two values, namely, 150 fibres only. These would correspond to a piece of the cochlear 0·4 mm. in length, a length which is less than half that affected by the drill. The experimental finding that the deaf region is narrower than the destroyed region is in agreement with the resonance theory.

(5) In recent experimental investigations on the auditory nerves, Wever and Bray have detected

electric currents which correspond in frequency and phase to the sound waves falling on the ear. This would be the case if the auditory nerve were behaving like a telephone circuit, and if the internal ear was acting like a microphone. This evidence, which is in favour of the telephone theory, is at variance with the resonance theory. Now, Adrian, who has recently repeated Wever and Bray's experiment, found that freezing or crushing the auditory nerve, or putting novocaine on it, did not stop the effect, which cannot, therefore, be due to the passage of nerve impulses along it.

It would seem that the phenomenon, interesting as it is, has nothing directly to do with the behaviour of the internal ear, so far as normal hearing is concerned. There would appear to be no justification at the present time in claiming these experiments as being in agreement with, or in contradiction to, the various theories of hearing.

(6) According to the resonance theory, a great many fibres are set into vibration by a single pure tone, and fibres at the edges of the group differ from the centre one, which is 'in tune' with the incoming vibrations, by roughly a semitone. Why, then, do we not hear a dissonant noise when a single frequency falls on our ears? Gray has answered this objection by supposing that in some way the sense organs attached to the fibres are able to detect the fibre which is performing the maximum amplitude of vibration; and that the brain, receiving impulses of a special kind up the nerves connected with this fibre, is able selectively to receive the frequency corresponding to this fibre and to ignore the impulses from all the other more outlying fibres which are set into vibration by the tone.

Not only is it extremely difficult to see how a suitable physiological mechanism could be devised to do this, but also it would place the ear in a completely different category from that of vision and touch. In vision, we meet a corresponding phenomenon, for a point source of light stimulates not one cone sense organ of the retina but many cones. This effect causes no confusion. We always have seen point sources (for example, stars) that way. We presumably shall continue to do so all our lives. So with hearing. Single pure tones have always set a certain number of fibres into vibration; it is an effect to which we are accustomed. It would seem entirely unnecessary to invoke a special, and unusual, type of mechanism to deal with the phenomenon.

CONCLUSION

When, fourteen years ago, Wrightson published his book, the telephone theory received at his hands an impetus which was just what it required. The resonance theory had fallen into disrepute, the telephone was replacing it, and people were hesitating between the two. Unfortunately for the telephone theory, it was not long before criticisms of Wrightson's book began to accumulate. So serious were these criticisms that Wrightson's views had to be wholly abandoned. Since then, evidence has been accumulating in favour of the resonance theory. Objections to it appear in many cases to be based on erroneous ideas with regard to resonators and sense organs. It would seem, at the present time, that the resonance theory accounts satisfactorily for all the phenomena of hearing, and that no other theory does this.

Royal Society of Canada

ANNUAL MEETING IN OTTAWA

ON May 26–28 the Royal Society of Canada met in the new building of the Canadian National Research Council in Ottawa. Several features of the meeting arose out of the fact that the Society was celebrating its jubilee. Learned societies of Great Britain, France, and the United States sent delegates. The presidential address by Sir Robert Falconer, on the evening of May 26, was an eloquent and instructive survey of the remarkable progress of the intellectual life of Canada during the past half-century, as reflected in the proceedings of its Royal Society and, in fact, dominated by the fellows of the Society. This address and a series of detailed histories of the progress in special fields are assembled in an anniversary volume, entitled "Fifty Years' Retrospect". At the same evening meeting, delegates were received, a diploma was presented to the Prime Minister, Mr. Bennett, and the various medals were awarded, namely: the Flavelle Medal to Dr. J. S. Plaskett for his contributions to astronomy, the Lorne Pierce Medal to Dr. Archibald MacMechan for achievements in literature, and the Tyrrel Medal to Dr. Pierre-Georges Roy for his historical researches.

A new function of the Society appeared in the announcement by the Council of the award of ten fellowships endowed by the Carnegie Institution.

At the meetings of Section 1 (French Literature and History) twenty papers were read, and of Section 2 (English Literature and History) twenty-five papers were read.

The presidential address to Section 3 (Physics, Mathematics, Astronomy, and Chemistry) was delivered by Prof. A. Norman Shaw, who gave an interesting account of the developments in physics during the last fifty years. He paid tribute to the work done by physicists in Canada, dwelling especially on the contributions made at McGill by the late Prof. H. L. Callendar, Lord Rutherford, and by Prof. J. C. McLennan in Toronto. After reviewing the work in physics of the past and present fellows of the Section, he concluded his interesting address with a plea for closer co-operation between science and government with the words: "We await Governments which will devote their major expenditures of effort, time, and money in studying and directing the efficient harvesting and even

distribution of the knowledge and power which Science places at their disposal ".

More than a hundred papers were presented to Section 3, which split up into the three divisions of physics, chemistry, and mathematics (including astronomy) in order to get through the programme during the meeting. In the physics division, interesting papers were given by Prof. L. V. King on " New Singular Solutions of Maxwell's Equations and Applications to the Calculation of Radiation Fields of Wireless Antennæ ", in which he demonstrated that the exact theory of radiating antennæ could be given. Prof. J. A. Gray gave several papers on the scattering of β-rays. His results indicated that the range of β-rays from radium-E are much greater than the values found by other observers, the range in aluminium and lead being about the same. The loss of energy in the scattering increased with increase in angle of scattering, but could not be accounted for by penetration of the nucleus. The loss in energy, amounting to 20 per cent, went off in the form of radiation which was not X-rays. Dr. R. W. Boyle presented a number of papers by the members of the Canadian National Physical Laboratory on various topics. In a paper on the passage of ultra-sonic waves through thin plates of glass, the experimental results showed that Rayleigh's theory is inadequate. C. D. Niven spoke on heat insulation of fibre boards, G. C. Laurence on a new type of γ-ray ionisation chamber for radium calibration, and L. E. Howlett on " Some Theoretical Considerations on the Intensities of Raman Lines ". Prof. A. N. Shaw described a new theorem by which all the thermodynamical relations involving first and second derivatives of the different variables for a simple substance can be rapidly deduced.

There were several papers on applied geophysics, amongst which Prof. L. Gilchrist's application of geophysical methods to the determination of stake resistances of earth contacts associated with power transmission lines and Prof. L. V. King's mathematical investigation on potential problems in semi-infinite stratified media were of interest. Dr. G. M. Henderson and S. Bateson spoke on a quantitative study of pleochroic haloes. Prof. A. S. Eve gave an interesting account of proposed experiments on the Kennelly-Heaviside layer during the total solar eclipse of Aug. 31 this year, when observations will be made to detect a possible eclipse of particles emitted by the sun. Dr. H. T. Henderson added some remarks on the work being undertaken in England on the determination of the height of the K-H layer. The secretary of the Section, Mr. J. Patterson, presented a paper on " A Source of Error in Measuring Radiation on a Horizontal Surface ", and Mr. Andrew Thomson a paper on the results of an analysis of 171 pilot balloon observations taken in the central Pacific from the research yacht *Carnegie*, from which the trade and anti-trade wind circulation in the Pacific was deduced. Prof. H. A. McTaggart gave an account of a study of Brownian movement in thin films of various substances on water or aqueous solutions.

Among the numerous papers on spectroscopy, Prof. J. K. Robertson gave an account of the change in the type of spectra, from the spark to the arc spectrum, with the presence of continuous bands when thallium vapour at different temperatures is excited with the electrodeless discharge. Damped and continuous waves were used and different effects obtained. Prof. J. C. McLennan and his co-workers presented several papers. A definite change in the scattering of light was observed at the critical point in liquid helium. In association with H. D. Smith, the Raman effect in liquid and solid carbon dioxide was found to give four frequency changes which were the same as those found in the gaseous state. The absorption spectrum in the band spectrum of xenon was investigated, and in another paper the wavelengths of some copper lines in the extreme ultraviolet were accurately measured with a Fabry-Perot interferometer and a spectrograph. Prof. J. S. Foster described the mounting for a thirty-foot grating spectrograph for observing the flash spectrum during the coming solar eclipse. A paper on the Stark effect in the red region of the xenon spectrum, by J. F. Heard, indicated a Stark displacement in 89 lines.

Among the dozen papers in the mathematics and astronomy division, Prof. S. Beatty spoke on geometric characterisation of lineal transformations; S. A. Lischinsky and W. J. Webber on the representation of almost all positive integers in the form plus square; and Dr. J. Synge on variational principles and dissipative systems. Dr. W. E. Harper gave a paper on the wave-lengths of *A*-type stars and also one on the orbits of four spectroscopic binaries.

More than forty papers were presented in the chemistry division. Of the several papers presented by Prof. O. Maass and his students, two dealt with the absolute density of dry cellulose and the sorption of sodium hydroxide on cellulose and on wood. Another paper, by A. R. Williams, Prof. O. Maass, and Prof. F. M. G. Johnson, described the results of the measurement of the heats of solution of sulphur in carbon disulphide over a large range of concentration, from which an estimate of the total surface energy of sulphur was made. Energy transfer between complex gas molecules and solid surfaces was dealt with by E. W. R. Steacie and H. A. Reeve. Dr. R. H. Clark presented several papers on the separation of rare earth elements. Prof. H. E. Bigelow read a paper on the production of *p*-nitrobenzaldehyde by sodium arsenite, in which the results were materially different from those obtained when other reducing agents were used.

Prof. C. A. Chant was elected president of the Section for the 1933 meeting, and Mr. John Patterson continues as secretary.

Section 4 (Geology) received twenty-four papers, several of which were read by title. The papers actually presented evoked interesting discussion at the well-attended meetings. An important report by the National Committee on Stratigraphical Nomenclature was presented by F. I. Alcock. A

series of papers on batholiths was a prominent feature of the meeting, the contributors being S. J. Schofield, F. A. Kerr, H. C. Gunning, Prof. J. S. De Lury, and J. F. Wright. A new theory of the source of the siliceous solutions from which asbestos is produced was put forward by H. C. Cooke in a paper on their silica content. G. A. Young reviewed fifty years of geological investigation of the Canadian Shield, stressing the changes which have taken place and may yet take place in the fundamental ideas regarding this branch of geology.* The president-elect of the section is Prof. E. L. Bruce.

In Section 5 (Biological Sciences) ninety-six papers were read, part of the time in divided session. In his presidential address, Prof. J. B. Collip reviewed the work carried out under his direction on the œstrogenic substances and the anterior pituitary-like substance of the human placenta. Various aspects of this work were later discussed in detail by some of his collaborators. The interrelation of calcium metabolism with the parathyroid glands and with irradiated ergosterol was the subject of a series of papers by other members of the same department and also by Prof. N. B. Taylor. Prof. C. H. Best discussed the possibility of preventing fatty degeneration of the liver in diabetic animals by administration of choline, and presented a series of papers by Dr. D. A. Scott on the chemistry of insulin. Prof. J. G. FitzGerald read papers from his laboratory in the field of immunology. Important papers were also read by Prof. S. E. Whitnall on the causes of exophthalmos, and by Prof. B. P. Babkin on the liberation of a hormone from the nerve-endings of the chorda tympani.

The life of reindeer and other mammals in relation to segregation, sexual isolation, and evolution of species was discussed by Prof. Seymour Hadwen. Prof. A. Willey described a new species, *Nebaliella Caboti*, the first of the genus recorded from the North Atlantic, and showed that another form, *Epineballia pugettensis*, is distinguished generically from *Nebalia* by the structure of the male. Prof. E. M. Walker presented several papers, amongst which may be mentioned one by F. P. Ide on the effect of the temperature gradient of a stream upon the insect fauna, and another by himself on prognathism and hypognathism in insects. One food chain of the sea, from diatoms to fish through copepods, was demonstrated in a paper by C. W. Lowe, presented by Prof. A. H. R. Buller.

The botanical papers were varied and interesting. Those dealing with morphology, including a correlation of resin cyst production in hemlock, in response to wounding with seasonal growth; an account of the origin of rays in Gymnosperms in relation to taxonomy (both papers by M. W. Bannans); and an account of the organisation of the young sporophyte of *Isoetes*, based on anatomy, in comparison with that of other Pteridophytes (by W. K. W. Baldwin) were presented by Prof. R. B. Thomson. Prof. Marie Victorin recorded several examples of the transformation of the concrescent carpels of *Aralia nudicaulis* into five simple leaves or leaflets. Dealing with fungology were several papers from Prof. Thomson's laboratory on the subject of rusts and other fungi, and a very interesting account of hyphal fusions and their significance by Prof. A. H. R. Buller. Plant physiology included some important papers by Prof. G. H. Duff and Dorothy Forward, on respiratory metabolism and sugar changes in wheat leaves kept in the dark, and on the influence of this on their reaction to rust infection. Prof. F. E. Lloyd criticised M. Kruck's revival of the theory that the door of the trap of *Utricularia* is an irritable mechanism. An intensive study of the water balance of certain Canadian trees throughout the year and its bearing on problems of tree physiology was given in a paper by R. D. Gibbs. Dealing with cytology and genetics were papers by Prof. C. L. Huskins, adducing evidence of the homology between somatic mitosis and germinal meiosis, which indicated that the latter is brought about through retardation of the splitting of the chromonemata during the last premeiotic division. Taxonomy and ecology were represented in a series of papers by Prof. Marie Victorin and his associates. Of especial interest was the account of ecological modifications in the riparian flora of the St. Lawrence River, due to exceptional low water levels, and of the spread and adaptability (for example, to growth in deep water) of the introduced species *Butomus umbellatus*. Prof. J. G. FitzGerald was elected president of the Section.

The president of the Society for the ensuing year is Prof. Francis E. Lloyd, Macdonald professor of botany in McGill University.

Obituary

Prof. G. Baldwin Brown

We regret to record the death of Emeritus Prof. Gerard Baldwin Brown, which took place at Edinburgh on July 12, at the age of eighty-two years. Born in London on Oct. 31, 1849, he was educated at Uppingham and Oriel College, Oxford—of which later he became a fellow—obtaining a second class in Honour Moderations and a first class in Literæ Humaniores in 1873. His success in winning the Chancellor's prize for an essay on "The Short Period during which Art has remained at its Zenith in Different Countries" was an early indication of the bent of his mind, a bent which was further strengthened by his election as a fellow of Brasenose College, where he was brought into touch with Pater. He left Oxford to take up painting in London, and was afterwards appointed the first Watson-Gordon professor of fine art in the University of Edinburgh, at the early age of thirty-one. This chair he held for fifty years, retiring at the end of the academic year 1930, a period equalled only twice in the annals of the University.

Baldwin Brown's early essay in the history of art while he was still at Oxford had indicated that his

approach to art was archæological and historical rather than purely æsthetic; and interest in that line of inquiry grew as his life-work developed. His earliest book was "From Schola to Cathedral", a study of early Christian architecture. His outstanding and most enduring work is "The Arts in Early England", a monumental effort and an established authority, in five completed volumes and part of a sixth, published at intervals between 1903 and 1930, which displays a wide knowledge of the facts and indefatigable industry. In it, as in a smaller but comparable work, "The Arts and Crafts of our Teutonic Forefathers", he stressed—unduly, many archæologists would now say—the contribution of the Teutonic races in the artistic origins of Britain and North and Central Europe generally. The knowledge of æsthetic principles and theory which Baldwin Brown brought to bear on the archæological problem in his larger work was also used to advantage when dealing with palæolithic art in "The Art of the Cave Dweller" (1928), his Munro Lecture, a book for the preparation of which he had visited the caves of France and Spain, though then nearly eighty years of age, and in which the large number of illustrations, many of them of the less known examples of cave art, was used with striking effect in demonstrating with precision, from what to most archæologists was a new point of view, the æsthetic qualities of palæolithic painting and engraving, as well as the intentions and achievement of the artist.

In addition to the books already mentioned, Baldwin Brown was the author of "Anglo-Saxon Architecture", "The Life of Anglo-Saxon England in relation to the Arts", "The Care of Ancient Monuments", and a number of books on individual painters or matters of artistic technique. He was a fellow of the British Academy, of the Finnish Archæological Society, of the Yorkshire Philosophical Society, an associate of the Royal Institute of British Architects, and hon. LL.D. and D.Litt. of the University of Edinburgh.

We regret to announce the following deaths:

Prof. Fran Jesenko, professor of botany in the University of Ljubljana, Yugoslavia, known for his work on the genetics of wheat and rye, on July 14, aged fifty-seven years.

Prof. Graham Lusk, For.Mem.R.S., professor of physiology in Cornell Medical College, New York, a distinguished worker on the physiology of nutrition, on July 18, aged sixty-six years.

News and Views

A Century of Medicine

The Right Hon. Lord Dawson of Penn delivered his presidential address at the centenary meeting of the British Medical Association on July 26, taking as his subject "A Hundred Years and After". Lord Dawson traced the art of healing from the Egyptian Imhōtep (*circa* 3000 B.C.), through the well-known Greek era, to the Christian era, where at the beginning there was a retrogression, Christianity at that time delaying rather than promoting medical progress. The greater part of Lord Dawson's address, however, was devoted to the directions along which medical knowledge has grown during the last hundred years. The Reform Bill of 1832 forced masses of the population to dwell in towns, with the result that the prevailing conditions, due to lack of knowledge of public health and sanitation, caused misery, ill-health, and discontent. During the year of the Association's birth, there was a cholera epidemic raging over England and Wales, during which the number of deaths exceeded 50,000. At that time the idea prevailed that epidemic diseases were visitations beyond our ken and control. Even then, however, great minds were working: Virchow in cellular pathology, Bernard in physiology, Bright in medicine, and Chadwick in sanitation.

Medicine and the Basic Sciences

The dawn of the new era in medicine occurred, however, in 1857, with Pasteur's discoveries. These were soon followed by those of Lister, and thus began a quick succession of discoveries by men well known in the history of science and medicine. To-day there is a stronger link with medicine and the pure sciences. Physics and chemistry, with physiology, have taken pride of place in their services to medical knowledge. Radiology has the discoveries of Röntgen and others as its basis. Chemistry has afforded incalculable aid to therapeutics. The value of the scientific investigations of the seven known vitamins to medicine need scarcely be emphasised. Hormones and virus diseases are now of great importance to the study of physiology and pathology. The kinship between medicine and education was also emphasised by Lord Dawson. Still closer co-operation is required in the quest for knowledge. The Medical Research Council is doing a great service in supporting and directing efforts, wherever they come from, and it maintains contact between workers and between the institutions to which they belong. "There is, however, need for further co-ordination among bodies which represent varied aspects of medical knowledge such as the basic sciences, medicine, surgery, obstetrics, education, and administration."

Progress of Rational Medicine

Sir Charles Hastings, founder of the British Medical Association, was a native of Worcester, and part of the centenary meetings of the Association took the form of a visit to Worcester on July 24 and a commemorative service in the Cathedral, with a sermon by Dr. E. W. Barnes, Bishop of Birmingham. Dr. Barnes's text was "Honour a physician with the honour due unto him" (*Ecclesiasticus*, xxxviii. 1). Modern science and medicine began with the publication by Copernicus of his heliocentric astronomy and the production by Vesalius of his work on the anatomy of the human body. Nearly four centuries have

passed since then, and the human mind, freed from the shackles of medieval authority, has advanced at an ever-increasing rate. Great progress has been made in medicine and science, and the "new biology exhilarates by its possibilities"; advance along present lines gives visions of a great measure of immunity from disease and a finer race of men than the earth has yet known. Progress depends, however, in medicine as in science, on the unprejudiced search for truth, on original investigation. During the nineteenth century, conditions became increasingly favourable for medical research, until now it is well organised and receives State support. But what of the future? Dr. Barnes fears that we are not yet safe from religious reaction. New aspects of truth often bewilder and arouse instinctive opposition, which in turn invokes religious sanctions. Pseudo-religious prejudice opposes eugenic measures, as dissection and vaccination were opposed in the past, and faith cures may be associated with impatience of the sufferer with half-won knowledge. Social leaders, religious teachers, scientific workers, and medical men must join in emphasising that man has been endowed with his rational powers in order that he may discover the truth. Science is dynamic, and our faith, likewise, is the more inspiring because it also is dynamic.

British Medical Journal

THE issue of the *British Medical Journal* for July 23 is a special number commemorative of the centenary of the British Medical Association, which has been celebrated during the past week in London. Sir Humphry Rolleston contributes a review on "Changes in the Medical Profession and Advances in Medicine during Fifty Years", and Sir D'Arcy Power, in "A Century of British Surgery", describes the progress of surgery. The history of the Association is surveyed in a special article entitled "The First Hundred Years", with portraits of Ernest Hart and Sir Dawson Williams, prominent among the editors of the *British Medical Journal*. A notice is also devoted to Sir Charles Hastings, the founder of the Association, and the Association's headquarters in Tavistock Square, London, are described, with a coloured plate illustrating the imposing Great Hall.

Park Wood, Ruislip

ON July 23, the Earl of Crawford and Balcarres, who is chairman of the Council for the Preservation of Rural England, declared Park Wood, Ruislip, in Middlesex, a sylvan area of 237 acres, and the property of King's College, Cambridge, as dedicated for public use, in perpetuity. It has been acquired through the assistance of the Middlesex County Council, coupled with that of the Ruislip-Northwood Urban District Council. Complementary to the above is the gift by the College of the ancient manor house, its farm buildings, old-world gardens, and lofty and impressively timbered barn, one of the largest in the country, which accommodated nearly three hundred persons at the ceremony. Lord Crawford expressed the hope that the woodlands might always remain as such, and be truly English in character. The kindly agencies of Nature would sanctify them through their flora and fauna, and in particular there was the inspiration of bird life. Congratulations were extended to the provost and fellows of King's College on the happy arrangement effected.

THE Bursar of King's College, during his speech, recalled the original connexion of the College—extending over five centuries—with this Middlesex parish. It dated, in fact, from 1461, when Henry VI. granted to the provost, Robert Wodelark, and the scholars of the College, "the Manor of Ruyslepe . . . and all lands belonging". The king had, in 1440–41, entrusted to three commissioners his authority to proceed in the matter of a college which he proposed to found, and had indeed lived to see the magnificent chapel of King's completed. It was a sister foundation to that at Eton. In the nineteenth and twentieth centuries many changes have been experienced by the College, as trustees, whilst 'town-planning' schemes and urbanisation have cast their burden of responsibility. The Bursar disclosed that, so late as 1906, an offer of no less than £48,000 was made by a syndicate for the establishment of a racecourse; the offer was withstood, however, by the casting vote of the provost of that time.

Early Man in America

A FURTHER detailed research report on the discoveries of flint implements said to be associated with fossil remains of Pleistocene mammals in Nebraska, to which we referred in our issue for July 16, p. 87, has been made to Science Service, Washington, D.C., by Dr. W. D. Strong, of the Bureau of American Ethnology. It presents several points of interest. The Cumro find of an arrow-head, or rather 'point', associated with the extinct *Bison occidentalis*, lay under 16 ft. of loess of 'Peorian age', which is thought by the discoverer to be prior to the last or Wisconsin glaciation; but Dr. A. L. Lugn, of the University of Nebraska, the specialist in Nebraskan and Iowan Pleistocene deposits, regards this dating with some doubt, as some 'Peorian' deposits are unquestionably recent. On the other hand, the same authority, after a personal examination of the site of discovery of the second flint implement on the Platte River, also said to have been associated with *B. occidentalis*, while recognising that the exact age cannot be determined with finality, is of the opinion that the deposit shows considerable antiquity. It may be of 'Peorian' age; and it shows Kansan sands and gravels as the basal member. It has also transpired that the association of flint artefact and remains of *B. occidentalis* is supported by a hitherto unreported discovery in 1923, when a chipped point was found in association with a skull and part of the skeleton of this extinct bison in the Meserve quarry. By far the most interesting find, however, from the point of view of dating, is that at Angus, where the "Folsom type arrow-point" was associated with the mammoth. Unfortunately, here the association lacks corroboration; but the sands and clays in which the mammoth bones were laid down appear to belong to the Yarmouth interglacial, which corresponds with the Mindel-Riss of Europe. In any event, the implements belong to a hunting culture hitherto unknown in Nebraska.

Military Conquest and Civil Settlement

FOR his presidential address to the Devonshire Association on June 21 Mr. J. J. Alexander surveyed "The Saxon Conquest and Settlement". Although he gave a very wide interpretation of his subject, devoting a considerable portion of his address to the question of evidence—historical, legal, and scientific—yet he brought together a useful résumé of what has been written on the matter. He made great use of the recently published volume of the Place Names Society on Devonshire, and summed up his paper by arriving at six probable conclusions: the first, as to the sparsity of the population of the district in the seventh century, and the remaining five regarding the campaigns of the seventh and eighth centuries in the west of England. Mr. Alexander has not, however, distinguished quite sufficiently between conquest and settlement. The military leaders and their soldiers prepared the way for the settlers who later, and sometimes much later, came with their wives, families, and baggage and travelled perhaps by a different route from that by which the soldiers marched. The study of place-names is most important for the history of the Saxon period, but, besides archæology and written history, it needs to be supplemented by studies of the varied systems of agriculture and the distribution of types of villages by the aid of the ordnance map—"that marvellous palimpsest which, under Dr. Meitzen's guidance, we are beginning to decipher", as Prof. Maitland has pointed out. Something has been done in this respect for eastern England, where the evidence is clearer, but in the west, where the evidence is more confused and difficult of interpretation, the subject has received little attention.

Prehistoric Society of East Anglia in 1931

THE recently issued *Proceedings of the Prehistoric Society of East Anglia* for 1931 (vol. 6, pt. 1) contains a number of communications of importance for prehistorians. The presidential address by Mr. J. P. T. Burchell on "Early Neanthropic Man and his Relation to the Ice Age" has already been the subject of reference in NATURE (Nov. 21, p. 879; 1931). It is printed here in full with ample illustration. Among the remaining papers, Mr. Bertram Brotherton describes a remarkable rostrocarinate implement of quartzite from Worcester, upon which Mr. Reid Moir remarks that it may be less ancient than its type suggests. Mr. Reid Moir himself chronicles further discoveries of flint implements in the brown boulder-clay of north-west Suffolk. He is now inclined to think that the brown boulder-clay was laid down before the Magdalenian period began. In a paper on the flint industries of the type station of La Madeleine, Mr. A. S. Barnes discusses their value as a basis for the classification of Magdalenian industries elsewhere. Mr. A. Leslie Armstrong deals with his further excavations in the Pinhole Cave at Creswell Crags and on a late Aurignacian site in Lincolnshire. Mr. A. L. Grimes, in dealing elaborately with the early bronze age flint-dagger in Britain, suggests that while it was undoubtedly introduced into Britain with the beaker culture, it shows resemblances to both the two main Continental groups, the northern and the Mediterranean. An account of the excavation of an early iron age site at Great Wymondham, Herts, by Mr. C. F. Tebbutt, is especially noteworthy, as sites and finds of this 'early phase' (La Tène I. and II.) are rare in that area.

John Fitch, Pioneer of Steam Navigation

IN the June issue of *Mechanical Engineering*, Mr. W. H. Richardson gives a sketch of the career of "John Fitch: Patriot, Martyr, Pioneer Steamboat Inventor". Fitch was born in 1743 and died by his own hand in 1798, having during the last fifteen years of his life devoted himself with fluctuating fortune to the promotion of steamboat enterprises. He was the first in the world to form a steamboat company and to place a steamboat in service for carrying passengers. His work was done at a time when there were no engineering shops in America and when the export of machinery from England to the United States was prohibited, and there can be little question that had he had the assistance of Watt and Murdock and their fellows, his schemes could have been brought to a successful issue. Above all, however, he was a man of vision, and while realising the great value of steamboats on the great waterways of America, he once wrote of steam navigation, that "The Grand and Principle Object must be on the Atlantick, which would soon overspread the wild forests of America with people and make us the most oppulent Empire on Earth". The earliest experiments of Fitch were made on the Delaware between 1786 and 1790, and were contemporary with those of Rumsey on the Potomac and of Miller and Symington in Scotland. To-day there is a monument at Trenton, on the "John Fitch Way" beside the Delaware, marking the site of the New Jersey terminus "of the first merchant marine highway in the world".

Heating the Soil Electrically

THE South Wales Electric Power Company of Cardiff is distributing pamphlets to farmers giving them useful information on the advantage of the electrical heating of the soil in frames used for growing vegetables and fruit for the early market. The soil is heated by means of a 'thermal' cable buried in the soil and carrying at certain times of the day electric current. British and continental firms are now manufacturing this kind of cable, and an electrical contractor will install it. This pamphlet demonstrates by photographs how much more rapidly a cucumber will grow in an electrical hotbed than in an ordinary frame. It is pointed out that Norwegian and Swedish market gardeners and farmers produce lettuce and other market plants at out-of-season periods by this method. It is also useful in growing cantaloup melons and other expensive fruits at times when they are very dear. It is suggested that the electrical heating of the soil may prove useful for the growing of mushrooms, and would be a pleasanter method than the one ordinarily used. Experiments with this end in view could easily be carried on in a cupboard or a cellar. Orders have been issued under the provisions of the Horticultural Products Act imposing

duties on vegetables, fruits, and flowers. One of the effects of this order will be to keep out luxury products, and will give gardeners an opportunity of capturing a market which has hitherto been beyond their reach. There is now to be a duty of eight shillings per cwt. on all foreign lettuce from Jan. 1 until April 30. It is easy to compute the exact cost of the electric installation required; and where electricity is cheap, much can be said in its favour.

International Industrial Agreements

IN a general report on the economic aspects of international industrial agreements recently prepared for the Economic Committee of the League of Nations, it is concluded that international agreements constitute an important attempt to remedy certain disadvantages of the present economic evolution. They are not a panacea and do not apply to all products; they may mitigate but not abolish economic crises. Like other human institutions, they are liable to error and even abuse, but experience has shown that they quickly pay for any mistaken policy, and a false step may even imperil their existence. When of long duration, their interest definitely coincides with the general interest, for example, in stabilising at moderate prices, eliminating dumping, stabilisation of customs duties, and of employment, and in minimising the fall of wages in periods of depression. The advantages of lower costs to producers are secured in various ways, such as regular production, diminution and standardisation of stocks, elimination of unnecessary transport, economies and increased efficiency in research and other technical matters, patents, marketing, sales organisation. The advantages of greater equilibrium between production and consumption and of relative stability in prices are equally beneficial to producer and consumer. Agreements do not eliminate competition, but the limitations they impose on competition are beneficial, as avoiding waste or destruction of capital. The existence of international agreements did not create the present crisis; on the contrary, the seriousness of the crisis intensified the movement for such agreements to mitigate its consequences. They are accordingly considered to constitute a valuable guarantee of the economic and political stability of the nations.

North American Oyster Fisheries

MR. H. P. SHERWOOD who, during 1930, was sent by the English Ministry of Agriculture and Fisheries to investigate the American methods of oyster culture, in his paper "The Oyster Industry in North America: a Record of a Brief Tour of some of the Centres on the Atlantic and Pacific Coasts, and of a Summer in Canada" (*J. Conseil*, vol. 6, No. 3, Dec. 1931), gives an interesting account of the industry in North America and the various beds visited. He spent a summer in Canada, working on oyster investigations in Malpeque Bay, Prince Edward Island, and also visited most of the oyster-raising areas on both coasts of the United States. Recent figures put the annual yield of the oyster industry in North America at about 73,000 tons of food, valued at more than 14,000,000 dollars. The oysters belong to large and small companies and individual owners of oyster schooners, or oystermen, who fish in shallow reserved portions of the public beds. The natural beds of *Ostrea virginica* on the Atlantic coast at one time flourished from Maine to Mexico, but have greatly dwindled, and on the Pacific coast the industry is now practically confined to inlets in the State of Washington. Cultivation lies chiefly in providing in the summer clean shell cultch on the beds for attachment of the larvæ, culling or separating and sorting oysters from clusters in the clutch, and planting spat and half-grown oysters, together with measures for destroying pests. There is a demand for a greatly increased supply of seed oysters in many of the oyster-growing areas, although natural falls may in some seasons be very prolific. A few years ago this stimulated renewed interest in the problem of raising spat artificially, but more recently research has been directed to extending the possibilities of securing good sets of natural spat and to destroying pests, rather than to developing hatchery methods.

The Gulf Stream

THE results of investigations on the behaviour of the Gulf Stream were communicated to a recent meeting of the American Geographical Union at Washington by Mr. P. E. Church. According to Science Service, Mr. Church discovered many irregularities in width and temperature but no clear seasonal fluctuations. The data were obtained by recording instruments installed on commercial vessels crossing the triangle of waters between Halifax, Bermuda, and the Georgian coast. Inshore water extends to about the hundred-fathom line, beyond which is a wide area of cool water, ending in a narrow band of cold water believed to be due to upwelling from the depths. The Gulf Stream lies beyond, and was found to be 50 miles wide off Cape Hatteras and not more than 70 miles wide south of Nova Scotia. Outside the Gulf Stream to the south-east lies a broad area of warm water reaching towards mid-ocean. During the winter months, and occasionally at other seasons, the Gulf Stream flows as a double stream, with a tongue of cold water between, which may pinch off the northern stream and push the main stream considerably southward. Mr. Church does not explain this deviation, but doubts if wind action is the cause. South of Halifax the northern edge of the Gulf Stream averages a distance of 290 miles offshore but varies between 230 and 420 miles.

Science and the Empire

THE July number of *Discovery* is devoted, in view of the Ottawa Conference, to the subject of science and the Empire. Sir Stephen Tallents manages to give in a very few pages a vivid picture of the varied scientific activities which, on the confines of the Empire, become particularly associated with agriculture, the mainstay of dominions and colonies alike. The close contact maintained between scientific work at different centres is emphasised in this review and

illustrated by specific examples, and this practice is commended to the statesmen now gathered at Ottawa. The Right Hon. Lord Lugard explains the plan of the African Institute, with the financial support of the Rockefeller Foundation, to make a detailed study over a five-year period of the results of the impact of European civilisation upon the tribal system. Dr. H. V. Taylor, Commissioner of Horticulture to the Ministry of Agriculture, writes upon science and Empire fruit growing. The keynote of this article is that variation of climate, in the vast area covered by the Empire, prevents standardisation of methods, so that the grower is thrown into the hands of the research worker. Wool research in New Zealand and Empire air routes are other topics akin to the main theme which are also discussed.

Acquisitions of the Natural History Museum

A SERIES of microscope preparations showing all the early stages in the life history of the graptolite *Climacograptus* has been presented to the Department of Geology of the Natural History Museum by the Sedgwick Museum, Cambridge. The preparations were made by Mr. Ian Cox from material which he collected from rocks of Ordovician age in Akpatok Island, Ungava Bay, Northern Territory, Canada. Graptolites occur in the oldest fossiliferous rocks, and are organisms of unknown relationships, but generally supposed zoologically to resemble the living sea-firs, or sertularians—minute colonies of polyps encased in a horny skeleton. In the material from Akpatok Island, the original horny skeleton is preserved in a matrix of limestone, which can be dissolved and the skeleton extracted entire. The minutest structure and ornament of the early chambers, or thecæ, are visible, and the order and manner of budding of new thecæ can be clearly determined. Miss K. B. Macvicar has presented the extensive herbarium of her brother, Dr. Symers M. Macvicar, to the Department of Botany. Dr. Macvicar was the recognised British authority on Hepaticæ and was the author of the standard systematic account of them, "The Student's Handbook of British Hepatics". The herbarium is very rich in British and Continental species, and these are the more valuable because they are the basis of the descriptions and comparisons in the "Handbook". Dr. Macvicar was a medical man whose home was at Acharacle, Argyll, and in his travels in western Scotland accumulated an unrivalled representation of the flora, particularly of the less frequented parts of Argyll and Inverness. The herbarium contains about 18,000 specimens (that is, labels) and, as well as hepatics and flowering plants, contains mosses, seaweeds, and lichens. Mr. A. H. G. Alston, assistant keeper in the department, has just returned from western Greek Macedonia, where, in company with Mr. N. Y. Sandwith, of the Kew Herbarium, he spent six weeks. He collected about 1200 specimens, chiefly flowering plants. These are of interest because the area along the Albanian frontier has been visited previously only by a Czechoslovakian collector; moreover, the districts visited overlap to some extent those from which some plants were obtained by the department during the War.

Protection of the Fauna and Flora of Poland

IF one may judge by the size and quality of *Ochrona Przyrody* for 1931, the publication of the National Council for the Protection of Nature in Poland, a very vital interest is taken there in the preservation of natural amenities. The articles contain proposals for the formation of reserves for the primitive flora of the Dniester valley and elsewhere; but, perhaps because the position of some of the animals is more precarious, we turned to find out what measures were being discussed for their behoof. The opinion is held unanimously that the chase of the red deer of the Carpathians during the period of rut is harmful to the species and is responsible for the annual degeneration noticeable in the herds. But agreement is not reached as to the best means of meeting the difficulty. The majority hold as a distant ideal the desirability of suspending all hunting during the period of the rut, but since the custom is old-established and widespread, a gradual approach to the desirable end is suggested. An interesting paper by Wladyslaw Burzynski, the chief forester, discusses the position of the bear in the eastern Carpathians. The War was responsible for the slaughter of much of the breeding stock, so that even now the number probably does not exceed three hundred in an area of about 300,000 hectares. A third paper describes a visit to the workings and lodges of two colonies of beavers, one on the Szczara, the other on the Niemen.

Research and the Wheat Quota

SIR ALBERT HUMPHRIES, chairman of the National Institute of Agricultural Botany, in the course of his address to the annual meeting of the Institute's fellows at Cambridge on July 21 showed how agricultural research helps the farmer to make good use of the wheat quota. The quantity of wheat grown in Great Britain has been steadily diminishing and the proportion used for poultry has increased, so that in the past season home-grown wheat represented only some seven per cent of the national grist. The wheat quota is likely to raise this figure considerably, and the quality of English wheat for bread-making may come into its own again. The Cambridge Plant Breeding Institute has produced, and the National Institute of Agricultural Botany is now testing, a variety of which the quality is markedly superior even to Yeoman. Yielding capacity is, however, of first importance, and there are often differences of up to 20 per cent between varieties. The Institute in 1930–1931 tested, by methods which can detect much smaller differences, some hundred varieties, of which twenty are new ones not yet on the market. Sir Albert Humphries urged that facts of this sort show the Institute to be working directly for the improvement of the farmer's financial position.

Courtauld Institute of Biochemistry

THE Courtauld Institute of Biochemistry of the Middlesex Hospital Medical School was given by Mr. S. A. Courtauld because the services of this department to the Hospital had increased so greatly that it was impossible to house it in the Institute of

Pathology any longer. The Courtauld Institute was opened in June 1928; the building consists of five floors devoted to general biochemical research, and particularly to clinical biochemistry. In this department all the routine analyses of the Hospital are performed. At the opening, Mr. Courtauld endowed the chair of biochemistry to the extent of £20,000. Unlike most donors, however, he has realised the heavy cost of running such a department, and being anxious that it should continue to be used to the very best advantage, has generously given the Institute a further sum of £20,000.

Dr. Otto Struve

IT is announced in a Science Service bulletin for June 18 that Dr. Otto Struve succeeds Dr. E. B. Frost as director of the Yerkes Observatory. Dr. Struve represents the fourth generation of the Struve family that has made valuable contributions to astronomy. He is a great-grandson of Dr. F. G. W. Struve, who did pioneer work on double stars at Dorpat and Pulkova about a century ago. The latter was succeeded at Pulkova by his son Otto, who continued the work on double stars, and made a study of stellar distances and the solar motion. Both of Otto's sons carried on the family tradition, at Berlin and Dorpat respectively. His grandson, the new director of Yerkes, was born in Russia in 1897, and studied at the University of Kharkov. In 1921 he became an assistant in stellar spectroscopy at the University of Chicago, taking the degree of Ph.D. in 1923. He has been at Yerkes since 1924, being in succession instructor, professor, assistant director, and now director.

Announcements

THE Medical Research Council has awarded Dorothy Temple Cross fellowships for 1932–33 to the following: Veronica B. F. Dawkins, resident medical officer, Maltings Farm Sanatorium, Colchester; G. M. Dean, formerly of the Department of Surgery, University of Aberdeen; Evelyn M. Holmes, formerly assistant tuberculosis officer, Welsh National Memorial Association; J. N. O'Reilly, formerly house physician, Brompton Hospital, London; Dr. W. G. Scott-Brown, assistant surgeon, Throat, Nose, and Ear Department, Royal Free Hospital, London.

BY an Order of the Committee of Privy Council, made after consultation with the Medical Research Council and with the president of the Royal Society, Prof. A. E. Boycott, Graham professor of pathology at University College Hospital, London, and Prof. E. D. Adrian, Foulerton professor of the Royal Society and fellow of Trinity College, Cambridge, have been appointed members of the Medical Research Council, in succession to Prof. Robert Muir and Sir John Parsons, who retire in rotation on Sept. 30 after four years' service.

THE ninety-second meeting of the German Association of Men of Science and Physicians will take place at Wiesbaden and Mainz on Sept. 25-29. Applications for membership should be made to Prof. B. Rassow, Gustav-Adolf-Str. 12, Leipzig, C.1.

THE ninth vacation course in practical air photogrammetry will be held in the Mathematical Institute of the University of Jena on Oct. 10–22. The course will be exclusively in English, and will consist of lectures and practical work. The lectures will be given by Prof. Otto von Gruber, Prof. Hugershoff, and Dr. I. Tappen. The subjects to be dealt with include photographic apparatus and material, method of survey and navigation, plotting apparatus, and applications of air photogrammetry. Applications should be sent to Zeiss-Aerotopograph, Postfach 117, Jena, Helmholtzweg.

THE summer meeting of the Institution of Mechanical Engineers, under the presidency of Mr. William Taylor, will take the form of a visit to Canada and the United States on Aug. 19–Sept. 19. At the meeting, there will be a discussion on a paper read by Dr. F. A. Gaby on "The Generation and Distribution of Power under the Administration of the Hydro-Electric Power Commission of Ontario" and an address by Mr. C. L. Stevens on "The Point Plan of Rewarding Management and Labour". Many visits to works and power stations have been arranged. Further particulars can be obtained from the Secretary, Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1.

A JOINT autumn meeting of the Iron and Steel Institute and the Institute of Metals will be held at the Institution of Civil Engineers, Great George Street, S.W.1, and the Institution of Mechanical Engineers, Storey's Gate, S.W.1, on Sept. 12-15. A large number of papers will be presented at joint and separate sessions of the institutions. On Sept. 12, Dr. H. J. Gough will deliver the annual Autumn Lecture of the Institute of Metals on "Corrosion Fatigue in Metals". Among the excursions and visits to works are visits to the National Physical Laboratory, Teddington; the General Electric Company's Research Laboratories, Lamp and Glass Works, Wembley; the Mond Nickel Co., Ltd., Acton Refinery; and the Ford Motor Co., Ltd., Dagenham Works.

MR. F. EDWARDS, 83 High Street, Marylebone, has issued an important catalogue of books on America. It includes the rare first edition of Linschoten's "Discours of voyages into ye Easte and West Indies" (1598), John Calef's "Siege of Penobscot" (1781), Morton's "New English Canaan" (1637), Johnson's "Nova Britannia" (1609), and a fine copy of Sir Walter Raleigh's "Brevis et admiranda descriptio Regni Guianæ" (1599), as well as many other unusual items.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mathematics at the Chelsea Polytechnic, London, S.W.3—The Principal (Aug. 4). A research fellow in glass technology in the Department of Glass Technology at the University of Sheffield—The Secretary (Aug. 6). An assistant lecturer in physics at University College, Nottingham—The Registrar (Aug. 10). A lecturer in applied chemistry at the Northampton Polytechnic Institute, St. John Street, London, E.C.1—The Principal (Aug. 22). A technical assistant for special investigation work in connexion with wireless valves—Messrs. Lissen, Ltd., Worple Road, Isleworth.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Nuclear Structure

THE experimental evidence for the existence of the neutron has given added support to the view [1] that the nucleus may be composed of protons, neutrons, and α-particles. Heisenberg [2] has recently found it convenient to use a model with protons and neutrons only as the building-stones. In various papers, Aston [3] has determined the isotopic constitution of many of the chemical elements, but it has not been possible to say, from considerations of stability, just what isotopes may be expected to occur. The purpose of this note is to point out regularities for elements of low mass, and to suggest a possible building-up principle for such elements.

Starting with an α-particle, let us add alternately a neutron and a proton. The resulting nuclei are He 5, Li 6, Li 7, Be 8, Be 9, B 10, B 11, C 12, C 13, N 14, N 15, and O 16. With the exception of He 5, these, and only these, have been observed for this mass range. With O 16, this type of regularity ends, which might be interpreted as due to the formation of some sort of a closed shell. To a first approximation, let us suppose the mutual interaction of the added neutrons and protons to be small compared with their interaction with the α-particle. Then, when a neutron and a proton are added, the resulting field will still favour a neutron over a proton. If an analogy with the external electronic system subsists, then the α-particle may represent a closed *s*-shell, with two neutrons and two protons, while O 16 is obtained by adding on a closed *p*-shell, with six neutrons and six protons.

The continuation of this process is the addition of a *d*-shell, with ten neutrons and ten protons. The stability conditions appear to be different, two neutrons being more stable in the central field than a neutron and a proton. The order of addition is as follows: neutron, neutron, proton, proton, and repeat. This results in O 17, O 18, F 19, Ne 20, Ne 21, Ne 22, Na 23, Mg 24, Mg 25, Mg 26, Al 27, Si 28, Si 29, Si 30, P 31, S 32, S 33, S 34, Cl 35, and A 36. With A 36, this shell becomes closed. These nuclei, and only these, have been found for this mass range, just as in the previous case.

If n denotes the total number of neutrons and protons together, then, except for $n = 3$, 5, and possibly 8, there exists an isotope for every value of n below 36, according to the experimental evidence. We should expect this to be a general property, holding for values of n greater than 36, also. In the range $36 < n < 64$, several points are missing, namely $n = 38$, 42, 43, 46, 47, 49, and 57. The corresponding isotopes probably exist in small quantities, but until they are found, it is rather difficult to determine stability conditions for this mass range. However, simple considerations lead to a prediction of certain isotopes. Since the neutron number for $n = 37$, 39, and 40 is 20, it might be expected to be the same for $n = 38$, giving A 38. Similarly, one can predict V 49, Mn 53, and Co 57. In this range $36 < n < 64$, which may correspond to an *f*-shell being completed, all the isotopes, except Cr 53, have even neutron numbers. This is so striking that one wonders whether or not the isotope reported for $n = 53$ is really due to chromium.

The analogy with the external electronic structure seems to indicate that for large values of n, conditions may become quite complicated. The experimental evidence bears this out. More information seems to be needed, however, before stability questions in general can be settled. Whether or not the α-particle plays a fundamental part remains to be seen, but we can certainly disregard it for the lighter elements, and consider protons and neutrons as being the elementary constituents.

JAMES H. BARTLETT, JR.
Zurich, July 1.

[1] J. Chadwick, *Proc. Roy. Soc.*, A, 136, 705; 1932.
[2] W. Heisenberg, *Z. Phys.* (in print).
[3] F. W. Aston, *Proc. Roy. Soc.*, 1927–31.

Tidal Oscillations of Gravity

IN an earlier communication,[1] we reported the results of experiments to determine as exactly as possible the variations of gravity. We have now succeeded in increasing the accuracy and in eliminating the disturbances to such a degree that now the oscillations of gravity due to the attraction of the sun and the moon are directly perceptible in the photographic registrations. The arrangement of the apparatus is the same as stated in our previous letter.[2] The principal success was achieved by using the alloy *WT* 10 made by Krupp as material for the spiral spring. This material has an infinitesimal temperature coefficient of elasticity. By careful and repeated heating over a period of several months, it was also possible to reduce to a small factor the elastic after-effect. By this means the disturbances due to temperature are strongly suppressed, and also the uniform shift is very much diminished. The sensitiveness amounted

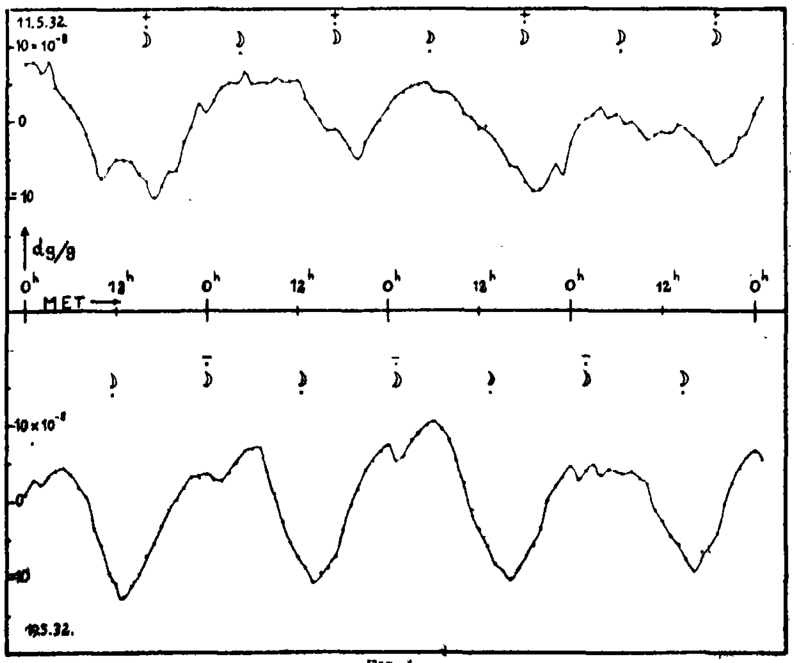

FIG. 1.

to a deflexion of 1 mm. for $dg/g = 10^{-8}$ at a distance of registration of 5 metres. With the aid of an electric method similar to the attracted disk electrometer of Lord Kelvin, the sensitiveness of the apparatus was often determined; therefore the indications of the registrations can be regarded as accurate to within $10^{-9}g$.

Fig. 1 shows an example of a record with no correction other than the elimination of the linear shift and the transformation of the readings to the same sensitiveness. Not only can the rough variation of gravity, especially due to the attraction of the moon, be seen,

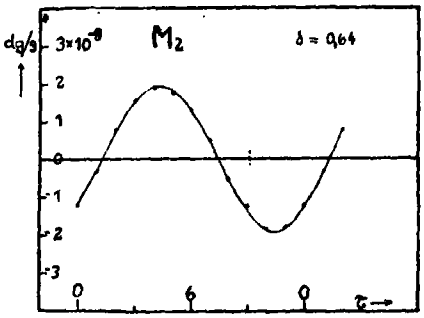

FIG. 2.

but also the finer features due to the alteration in the declination of the moon and in its position with regard to the sun. The transits of the moon over the meridian are marked (point above the sign is the upper transit); the sign + or − over the sign of the moon gives the declination of the moon on that day. In the upper part of Fig. 1 it can be seen how the influence of the moon, which had a positive (+) declination on those days, is at a maximum on its upper transit, producing at this time a pronounced minimum of gravity on the earth's surface. The lower part of Fig. 1 shows the greatest influence of the moon in the time of its lower transit, the declination of the moon being negative on those days. Since the gravimeter gives the vertical component of the alteration of gravity, the effect is the greater the smaller the distance of the celestial body from the zenith or nadir. With regard to the position of the moon relative to the sun, the upper curve corresponds to the neap tide, the lower curve to the tide of the full moon.

In consequence of these accurate and fairly well undisturbed records, the harmonic analysis of the curves gives very good results. The analysis of the term M_2 (period = 12·42 hours) was carried out as follows: the readings, after the elimination of the linear shift and after reduction to equal sensitiveness, were added for each 'hour' of the period and then divided by the number of periods. This gave for a time of about two months the curve shown in Fig. 2. Using the observations of one month altered the amplitude only by 2·5 per cent. This is in agreement with the corrections for short times of observations given by Börgen. We have also applied these corrections to the other terms of harmonic analysis. In this figure δ means the ratio of the observed amplitude to the expected amplitude, if the earth were perfectly rigid. The latter amplitude in Marburg is about $2{\cdot}97 \times 10^{-8}g$ for the mean time of the observations. In Fig. 2 the dotted line on the axis gives the expected position of the minimum, the full line gives the observed position. In the same way we have also obtained the terms O (25·82 hour period, amplitude expected for perfectly rigid earth $dg/g = 3{\cdot}1 \times 10^{-8}$) and even N (12·66 hour period, amplitude expected $dg/g = 0{\cdot}58 \times 10^{-8}$) in very good agreement, both in amplitude and in phase, with M_2. The term S_1, that is, the influence of the daily oscillations of the meteorological elements, appeared to be very small (if freed from the influence of K_1), especially compared with horizontal pendulum observations at the same depth (25 metres below surface-level).

The most significant result of the observations is, in the first place, that the observed amplitudes are *smaller* than the amplitude expected for a perfectly rigid earth, which seems to indicate a very much greater displacement of the surface than has been hitherto supposed. The second result is the displacement in phase of about three-quarters of an hour in the sense of a retardation of the maximum of variation of gravity. The ratio of amplitudes is for M_2 = 0·64, for O it is 0·74; this indicates an influence of the tides of the sea on the deformation of the solid earth, as is also observed in the experiments with horizontal pendulums. But this influence does not seem to suffice to explain the value of $\delta < 1$, which is in disagreement with the existing opinion.

R. TOMASCHEK.
W. SCHAFFERNICHT.
Physical Laboratory, University,
Marburg/Lahn, June 15.

[1] NATURE, **129**, 24, Jan. 2, 1932.
[2] See also *Astron. Nach.*, No. 5844, **244**, 257.

Mechanism of Superconductivity

IT was often assumed that the transition from normal conductivity to superconductivity may be connected with a kind of 'spontaneous coupling' of the conduction electrons. Some authors were even inclined to identify this phenomenon with ferromagnetism. Although this extreme point of view seems to be very improbable, some analogies with ferromagnetism must surely appear if any kind of 'spontaneous coupling' between electrons is re-

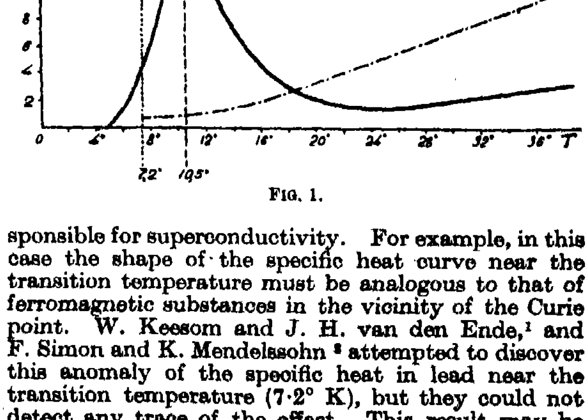

FIG. 1.

sponsible for superconductivity. For example, in this case the shape of the specific heat curve near the transition temperature must be analogous to that of ferromagnetic substances in the vicinity of the Curie point. W. Keesom and J. H. van den Ende,[1] and F. Simon and K. Mendelssohn[2] attempted to discover this anomaly of the specific heat in lead near the transition temperature (7·2° K), but they could not detect any trace of the effect. This result may be interpreted in two ways: either the hypothesis of the 'spontaneous coupling' of the conduction electrons in superconductors is completely wrong, or the number of the electrons which are concerned in conductivity is here so small in comparison with the number of

atoms that the specific heat anomaly of the conduction electrons cannot be detected with calorimetric methods.

As our measurements have shown, the specific heat anomaly of ferromagnetic bodies at the Curie point is so well pronounced in the thermoelectric effects (Thomson effect), that in spite of some difficulties concerning the sign of this effect, the order of magnitude of the specific heat anomaly can be computed from the purely thermoelectric constants in good agreement with calorimetric measurements. It is natural to try the same method in the domain of superconductivity. The recent investigations by J. Borelius, W. M. Keesom, C. H. Johansson, and J. O. Linde[3] of the thermoelectric force for lead and tin at the lowest temperatures permit us to compute the Thomson effect for these metals and to draw conclusions concerning the specific heat anomaly. Fig. 1 represents the Thomson coefficient for lead (as calculated from the experimental data) as a function of temperature. This curve is quite analogous to that of ferromagnetic substances, and it seems quite probable that it represents the general feature of the specific heat of the electrons concerned in the conductivity effects. It is not clear, however, why the temperature of the maximum of this specific heat curve (10·5° K) does not coincide with the transition point (7·2° K). Perhaps theory will be able to explain this discrepancy in the future.

From these results two important quantities may be calculated: first, ΔC_e (the height of the maximum of the specific heat curve), and secondly, ΔW_0 (the energy difference between the normal and the superconducting state at absolute zero), both for one electron.

	ΔC_e cal./degree.	ΔW_0 ergs.
Lead	8×10^{-25}	$1{\cdot}7 \times 10^{-17}$
Tin	$\sim 10^{-25}$	$\sim 0{\cdot}6 \times 10^{-17}$

If the number of the electrons was equal to the number of atoms of lead, the specific heat anomaly could certainly be detected, its numerical value being of the same order of magnitude as the normal specific heat itself. The precision of the calorimetric measurements permits us to determine the upper limit of the number of the electrons involved in the conductivity effects of lead. Actually it seems that the number of the conduction electrons is less than 1/200 of the number of the atoms in this case.

It is well known that magnetic fields destroy the superconductivity, the threshold value of the field H increasing as the temperature is lowered. By extrapolating the experimental data the value of H_0 may be found corresponding to absolute zero. We assume that the threshold value of the field is given by the condition that the magnetic energy of the electron $|\mu H_0|$ (where μ is the spin moment) is equal to ΔW_0.

$$|\mu H_0| = \Delta W_0 \qquad . \quad . \quad . \quad (1)$$

This assumption means that the superconductivity must be destroyed when the energy of the external forces exceeds the energy of the 'spontaneous coupling'. From (1) we may calculate H_0 for lead and tin, and compare them with the experimental results.

	H_0 expt. (gauss).	H_0 calc. (gauss).
Lead	2000-2500	2000
Tin	560	~ 700

According to the recent experiments of McLennan and his co-workers,[4] superconductors cease to be superconducting for high frequency currents if the frequency ν exceeds a certain threshold value. For tin at absolute zero, $\nu \sim 10^9$ may be found by extrapolation of the experimental data obtained at higher temperatures. It is interesting to notice that by assuming

$$h\nu_0 = \Delta W_0 = |\mu H_0| \qquad . \quad . \quad . \quad (2)$$

(where h is Planck's constant), we obtain for the same metal $\nu_0 = 1 \times 10^9$.

The remarkable coincidence between the observed and the computed data seem to support the general trend of the assumptions developed in this note. It is interesting to notice that the frequency of the Larmor precession corresponding to H_0 is equal to ν_0; thus the correlation between the two factors destroying the superconductivity may be found either on the lines of energetics or on the lines of the short time periods. Which of these interpretations corresponds to the real mechanism remains unsolved at this moment.

J. DORFMAN.

Physical-Technical Institute,
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Leningrad (21), U.S.S.R.,
May 23.

[1] *Comm. Leiden*, 230 *d*; 1930.
[2] *Z. Phys. Chem.*, B **16**, H. 1, 1932.
[3] *Proc. Amsterdam Acad.*, **34**, No. 10, 1931.
[4] *Proc. Roy. Soc.*, A, vol. 136, No. 829, 52; 1932.

Application of Knudsen's Law to the Evaporation of Water

RECENTLY it has been shown[1] that the maximum rate of evaporation of liquid carbon tetrachloride measured experimentally agrees to within the error of experiment with that deduced from the Knudsen equation

$$m = 43{\cdot}75 \times 10^{-6} P \sqrt{\frac{M}{T}} \qquad . \quad . \quad (1)$$

In this equation, T is the temperature of the evaporating surface and P the saturated pressure of the vapour at that temperature, m is the mass in grams evaporating per second, and M the molecular weight of the liquid.

In the case of water, however, the experimental rate of evaporation was found to be only from 1 to 2 per cent of that given by equation (1), and the discrepancy was ascribed to reflection of vapour molecules at the surface of the liquid.[2]

It will be seen from equation (1) that, in order to calculate the mass evaporating per second, it is necessary to know the surface temperature and the vapour pressure at this temperature. In the case of poorly conducting liquids, the surface temperature will be considerably below that of the liquid in bulk (20°-30° C. for water at 25° C.), and in the above-mentioned experiments it was measured by means of a thermocouple immersed in the liquid. As the latter evaporated, the thermocouple passed through the surface and so gave an estimate of the surface temperature. It is clear, however, that any instrument introduced into the liquid in this manner will give only an approximation to the surface temperature, since it actually measures the mean temperature of a thin layer near the surface. This average temperature will necessarily be higher than that of the true surface layer at which rapid evaporation is taking place. Hence the true value of T in (1) must be smaller than that given by the thermocouple, and it thus remained possible that, if more accurate values of T and P were obtained, the rate of evaporation deduced from equation (1) would agree with the experimental rate and the assumption of reflection would be rendered unnecessary.

It is hoped, however, that this possibility has been

eliminated in a new experiment in which the temperature of the surface has been deduced from measurements of the surface tension of the evaporating liquid. As this surface tension must be controlled chiefly by the temperature of the outermost liquid layers, a very close approximation to the true value of the surface temperature should be obtainable in this way.

As was to be expected, the surface temperature so measured was lower than that recorded by the thermocouple, so that the ratio (f) of the experimental to the theoretical rate of evaporation was somewhat greater than before. The difference was, however, not very marked. Whereas the surface temperature measured by the thermocouple gave values of 'f' ranging from 1 to 2 per cent, those deduced from the surface tension measurements gave values between 3·5 and 4·5 per cent.

The experiments therefore indicate that when the temperature of the actual evaporating surface layer is measured as accurately as possible, there is still a very considerable discrepancy between the theoretical and experimental rates of evaporation of water. This would seem to confirm the earlier suggestion that not all the vapour molecules striking the liquid surface are able to enter.

A detailed account of these experiments will be published shortly.

T. ALTY.

University of Saskatchewan,
Saskatoon, Saskatchewan,
June 27.

[1] Alty and Nicoll, *Canadian Journal of Research*, **4**, 547; 1931.
[2] Alty, *Proc. Roy. Soc.*, A, **131**, 554; 1931.

Proper Name of the Amœba

PROF. T. D. A. COCKERELL concludes his letter in NATURE of May 14, p. 726, on this subject, by the question: "What, then, is the proper name of the common amœba?" While we are awaiting the decision of the systematists, I should like to make some relevant remarks.

In 1916, Schaeffer classified those rhizopods which had the characteristics of Leidy's *Amœba proteus* into three species. Later, in his monograph on the "Taxonomy of the Amebas" (1926), he raised them to the rank of genera. Mast and Johnson (*Archiv für Protistenkunde*, 1931), in the paper that provoked Prof. Cockerell's letter, would reduce these three genera to the status of mere varieties. *Amœba discoides* (*Metachaos discoides*) has never been recorded in Scotland, so I cannot make any statement about the validity of its specific value, but in my long experience of the other two large amœbæ, so generally employed for class purposes, I should like to affirm that, in my opinion, Schaeffer rendered a real service when he cleared up these differences amongst the rhizopods commonly called by Leidy's name *Amœba proteus*. Confusion between the species to which he (Schaeffer) in 1916 applied the names *Amœba proteus* and *Amœba dubia* respectively had been responsible before that time for retarding progress in our knowledge of these animals.

Since 1916, other information has been forthcoming, all of which goes to support Schaeffer's contention that at least two distinct organisms had been confused under Leidy's name *Amœba proteus*. We now have a fuller knowledge of the life-history of one of these forms, namely, *Amœba proteus* (*Chaos diffluens*), and of the details of its nucleus (in development as well as in the adult state). These latter differ markedly from the corresponding details of *Amœba dubia*. Prof. Chambers finds that the cytoplasm of *Amœba dubia* is more suitable for micro-injection experiments than that of *Amœba proteus*, which seems to point to a fundamental difference in the cytoplasm of the two species. In short, the same specific name cannot be applied to them without resulting confusion.

There are of course well-marked varieties of *Amœba proteus* (*Chaos diffluens*). One variant, owing to an almost entire absence of crystals, is peculiarly translucent; it was the subject of much discussion at the Glasgow meeting of the British Association (1928). Other varieties due to size of nutritive spheres, etc., are also known. There is also a great variety in size (volume) in different strains of *Amœba proteus* cultivated under different conditions of food supply and temperature.

In discussing the contrasts in behaviour between Rösel's "kleine Proteus" and Leidy's *Amœba proteus*, Mast and Johnson state that they have never known any tendency of the latter to aggregate on the sides of the vessel. As a matter of fact, this condition is easily brought about in *Amœba proteus* (*Chaos diffluens*) by altering the food in the culture. This species is very fond of a diet of rotifers. Now, *Rotifer vulgaris* tends to form little clusters of individuals on the sides of the vessel. The amœbæ creep up after them, sometimes forming a beautiful carpet of individuals on the sides of the vessel containing the culture. Amœbæ also like encysted flagellates. These aggregate in the surface vegetable scum which often collects in cultures of amœbæ. In this 'scum' the agamonts produce agametes, as may easily be proved by skimming off a small quantity for inoculation into a new medium, when the young amœbæ may be seen hatching out of the cysts.

In my experience, isolated examples of *Amœba proteus* (*Chaos diffluens*) as well as of *Pelomyxa carolinensis* often develop the yellowish tinge referred to by Mast and Johnson—not, however, as they suggest, due directly to the colour of the food organisms present in the food vacuoles. I have always attributed this appearance in *Amœba proteus* rather to unfavourable environmental conditions. The same effect may be produced by slight lowering of the hydrogen ion concentration of the surrounding water. If the pH be not corrected, the specimens showing this yellowish tinge die off. Such facts should not be ignored when discussing the systematic position of Rösel's "kleine Proteus".

MONICA TAYLOR.

Notre Dame, Dowanhill, Glasgow,
June 10.

Pelomyxa carolinensis in Great Britain

CONSIDERABLE interest is attached to the name of the common large free-living amœba (*Amœba proteus*, Leidy) used extensively for teaching purposes. In recent discussions by systematists on this point, an organism known as *Pelomyxa carolinensis* plays an important part. This animal was renamed by Schaeffer (1926) *Chaos chaos*. Mast and Johnson (1931), quoting Schaeffer, say it has never been reported from Europe.

As I am at present engaged in a research on this animal, I should like to state that I have several records of its occurrence in the British Isles.

I am indebted to Sister Bernardine (Dr. Lucy Carter) for lending me some unpublished drawings of this species made by her from specimens obtained in Birmingham, Killarney, and the River Auchter (near Wishaw, Scotland), and to Sister Monica Taylor for records of its occurrence in the small pools along the shores of the head of Loch Fyne and in a tributary of the Allander River (Scotland). I myself at present am obtaining supplies from Loch Tannoch.

The specimens are smaller than those measured by Wilson (1900), as were those studied by Kepner and Edwards (1917), but the environmental conditions of the material I am collecting are almost identical with those described by Wilson.

ISABELLE P. MCGUIRE.

Shepparton, Milngavie.

The Whale Shark, *Rhineodon typus*, among the Seychelles Islands

THE publication in a recent number of *Science* of notes[1] on the occurrence of the whale shark in Bornean waters and on the Florida coast has led me to look over my notes and to put on record its occurrence and abundance in the Seychelles.

About six hundred miles north-east of Madagascar and four degrees south of the equator is found the Seychelles archipelago, formerly a French dependency, but now a British colony. To these islands, in 1868, came an Irish naturalist, E. Perceval Wright, for a six months' stay. To him we owe our first knowledge (and only published accounts) of the occurrence of the whale shark in this locality, where it is called the 'Chagrin'. He took photographs of two specimens (male and female), dissected two fish, and saw a number of others in the waters around the islands. It is greatly to be deplored that Wright made so little use of his opportunities to study this great fish. He wrote no article on it, nor did he publish his photographs (presumably the first ever made of the whale shark). Brief accounts, however, are given incidentally in four of his publications, in none of the titles of which does the name of the shark occur. There is nothing to form a guide, and only by running down obscure clues did I find accounts of the whale shark in the works listed below.[2]

The whale shark is as abundant around the Seychelles to-day as it was in 1868. In 1914 Dr. A. G. Mayor, director of the marine biological work of the Carnegie Institution of Washington, planned to send me to the Seychelles to study *Rhineodon*. Seeking information, I got in touch with Mr. P. R. Dupont, curator of the botanic station on Mahé, who informed me then, in 1919, and again in 1925, that the fish was comparatively common in the Seychelles. He had this information from many fishermen, and the managing director of the St. Abbs Whaling Company, situated on Mahé Island, also told him that the whale shark was abundant on the Seychelles Bank. Moreover, Mr. Dupont himself had at various times seen specimens, to the number of five or six. He further ascertained from an old fisherman that about 1865 there had been carried on by a family, of whom he was the only living member, a fishery for the 'Chagrin' to obtain oil from its liver. This man named eleven "grounds" where the fishing had been carried on, and said that when he was a boy of fifteen at Frigate Island the 'Chagrin' could be found all the year round. Mr. Dupont adds that to-day it is almost always to be found there in calm weather.

The War made the trip to the Seychelles impossible, so it was October 1919 when I again heard from Mr. Dupont. He reported that whale sharks were comparatively plentiful around the south end of Mahé Island, where a number had been seen a few days previously. As a result of this information, tentative plans were again made to go to the Seychelles, but the untimely death of Dr. Mayor in 1922 put an end to these.

In the meantime Mr. Dupont, who had been severely wounded in the War, was transferred to Mauritius, but returned to the Seychelles in 1924. Under date of July 27, 1925, he wrote me that *Rhineodon* was still not uncommon, and added:

> "According to our local fishermen, *Rhineodon* comes over to the Seychelles when *Caranx gymnostothoides* appears in enormous shoals from May to August, during the trades which blow heavily from the S. of Java toward the N. end of Madagascar, bringing on their way a good deal of fish to our archipelago. Advantage no doubt is taken by migratory fish of the currents which run in the same direction at this time."

Here then we have a suggestion as to how the whale shark has reached the Seychelles. This will become more apparent when one learns that *Rhineodon* is found in numbers in the East Indies and especially around Java. The abundance of the whale shark at the time of the schooling of the *Caranx* is not because the former feeds on the latter, but because both feed on a certain small sardine called 'tauve' and upon a little octopus called 'vauve', which abound in vast schools. In fact, the fishermen are guided by the presence of the 'Chagrin' to indicate good fishing grounds for *Caranx*. As to the breeding of *Rhineodon* in the Seychelles, the fishermen were in doubt, but Mr. Dupont definitely says that "The breeding season occurs in June". From this and from the statement that the fish is found all the year round, we may judge that, while it may have originally come from the East Indies long ago, it is now native to the Seychelles.

In my last letter to Mr. Dupont (September 1925), I asked him for any data that might have recently come to hand, and stated that I would like to bring together and publish that which he had sent me. Having had no answer, I fear that he has succumbed to his wounds. So the data about *Rhineodon* in the Seychelles have been collected and are now published in order to put the facts on record and to give Mr. Dupont credit for the information which he so kindly gathered and communicated.

E. W. GUDGER.

American Museum of Natural History,
New York City, June 17.

[1] Herre, A. W., "The Whale Shark on the Coast of Borneo", *Science*, 75, 413; 1932.
Gudger, E. W., "The Fifth Florida Whale Shark—1932", *Science*, 75, 412-413; 1932.

[2] (1) "Six Months at the Seychelles." Dublin, 1868, 16 pp. (Privately published and later included as one of the component parts of the next number—of which only 75 copies were published.)
(2) "Spicilegia Biologia." Dublin, 1870, pt. 1., pp. 64-65.
(3) "On a New Genus and Species of the Family Pandarina [Found Parasitic on the Whale Shark]", *Proc. Roy. Dublin Soc.*, 2 ser., **2**, 563-584; 1877.
(4) "Animal Life, or the Concise Natural History." London, 1870, p. 463.

Light and Sexual Periodicity in Indian Buffaloes

DR. MARSHALL has stated[1] that "in tropical countries where environmental conditions are similar throughout the year, such as the Cameroons, the native birds have no restricted breeding season but breed at any time". The data I collected in 1929 with regard to the buffaloes is of interest in this connexion.

The Government of Madras has stationed two buffalo bulls for stud purposes at the Agricultural Research Station, Kovilpatti (lat. 9° N.). During 1926–29 I noticed that a greater number of buffalo cows were brought to service in particular weeks of the months, which suggested that there was some periodicity in these animals coming on heat. The prevailing opinion amongst cattlemen was that more animals came on heat during periods of dark nights. With the aid of Tamil almanacs, I worked out a frequency curve of the services by these bulls during the previous ten years with respect to the new moon and full moon days occurring in each month. It was interesting to note (Fig. 1) two modes in the curve,

the higher falling on the new moon day and the smaller on the full moon day. This clearly indicated that the position of the moon would also influence

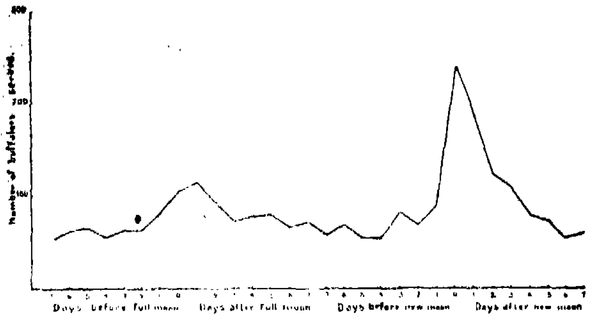

FIG. 1.

the onset of œstrum in buffaloes, if the buffalo cows brought to service could be taken as random samples of the buffalo population of the tract. When these data were retabulated according to the calendar months, a seasonal variation was also apparent.

	No. of Animals served.	Length of Nights on 1st of each Month.
January . . .	287	12 hr. 58 min.
February . . .	250	12 27
March . . .	248	12 13
April . . .	204	11 54
May . . .	218	11 36
June . . .	167	11 24
July . . .	169	11 21
August . . .	156	11 31
September . .	132	11 46
October . . .	155	12 5
November . .	199	12 23
December . .	272	12 36
Total . .	2457	..

It would appear from the above grouping that there exists an association between the length of nights and the number of œstrous animals. But when these figures were compared with the agricultural seasons of the year, it was found that the variations were more closely related to the availability of fresh grass than to the length of nights.

O. RAMANATHAN.

Agriculture College and Research Institute,
Coimbatore, May 19.

[1] NATURE, 129, 344, March 5, 1932.

Further Purification of Gonadotropic Hormones (ρ-Factors)

DURING the past six months a further advance has been made in the purification of the gonadotropic hormones (ρ-factors, prolans) based on methods previously described, in particular the observation [1] that certain coloured hormone solutions can be selectively filtered in such a way that the filtrate is strongly coloured, although possessing extremely low gonadotropic activity compared with that of the original solution. The filters most useful for this purpose were the 'ultrafein', 'mittel', and 'fein' filters supplied by the Membranfilter Gesellschaft of Göttingen; the first allows rather more rapid filtration, but is somewhat more porous to the active ρ-factors.

A solution of 2 gm. of ρ-factors (20,000 units per gm.) in 100 c.c. of distilled water is adjusted to about pH 7·2 and concentrated to about 10 c.c. by filtration. The residue is washed on the filters with successive portions of distilled water, and finally washed carefully off the filter and centrifuged to remove a small amount of insoluble matter. The solution (20 c.c.) is then treated with 100 c.c. of absolute alcohol plus 100 c.c. of ether. The flocculent precipitate is removed by centrifugation, washed with alcohol and ether, and dried. The yield is usually about 0·15-0·2 gm., and the activity is increased to 200,000 units per gm., provided that the washing on the filter has been sufficient. The process described takes about 8 hours up to the alcohol-ether precipitation, using two filters of 5 cm. effective diameter, but is a very trustworthy one for the preparation of small quantities of a highly active salt-free product.

In the absence of inorganic salts (as in this preparation) the ρ-factors cannot be precipitated from aqueous solution by alcohol alone, and further addition of ether is necessary.

This highly active product contains no sulphur, phosphorus, or halogen, and has a nitrogen content of about 8·4 per cent (9·1 per cent on an ash-free basis). Further, it does not give the ninhydrin reaction for α-amino acids until hydrolysed by dilute mineral acids, although it is inactivated by heating in neutral solution at 100° for half an hour. From these facts it would appear that the active principles are nitrogen-containing compounds, probably polypeptide in character, as has been previously postulated, [1, 2] although, in view of their thermolabile nature, one may be dealing with a case of adsorption.

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[1] Marshall, *Quar. J. Exp. Physiol.*, 21, 315; 1932.
[2] Wiesner and Marshall, *ibid.*, 21, 147; 1931.

Eradication of Slugs and Snails

IN the note on the "Eradication of Slugs and Snails" in NATURE of July 16, p. 90, reference is made to many of the accepted methods of dealing with these pests. The trouble with barriers of repellent material is that spreading plants such as violas, certain asters, carnations, etc., are difficult to surround without injurious contact to the foliage, and the slugs live amongst the roots. They appear, moreover, to prefer the flowers and foliage of these plants to the baits variously used, and extensive trials this spring with orange skins, bran, and bran mixed with Paris green were entirely ineffective. Examination after dark showed that each viola plant or carnation had as many as forty or fifty small white slugs feeding on it. As hand-picking was out of the question, a small pot containing a very strong solution of salt and permanganate of potash was carried, and each slug was touched with a knitting needle dipped in this solution. Half an hour spent each evening of one week has almost removed the trouble. I am not sure whether a solution of permanganate of potash without salt would be equally effective, and less harmful to the foliage if it touched it, but a single crystal of this salt will quickly kill a large snail. It is, however, not difficult to avoid damage to the foliage. For small upstanding plants, such as zinnia and dahlia seedlings, a collar of sheet zinc about one inch high is an absolute deterrent, and does not require renewal.

A. H. HALL.

Woodlands,
South Farnborough, Hants,
July 19.

Research Items

Anthropology of Carpathian Ruthenia.—A study of the racial characters of the Ruthenian inhabitants of the upland valleys of the Carpathians has been made by Prof. V. Suk, of which a preliminary report has been published (No. 150, *Pub. Fac. Sci. Univ. Masaryk*). The native Sclavonic population lives in long narrow villages which often extend for several miles along the deep valleys of the mountains. They fall into two groups, between which there are considerable cultural differences. They speak the same language but with dialectical variation. The Huculs, the eastern group, have dark hair, eyes, and skin, and are of tall stature, averaging five feet eight to nine inches, many men reaching six feet. The head is brachycephalic (av. index 84). Dinaric faces are not rare; but these have green-blue or dark blue eyes. Other members of this population have features approaching the Alpine; but the average complexion is darker than is usual in 'alpine' countries. On the whole, they are healthy. Tuberculosis is rare; but goitre is common. The western group, known by different names locally, is much poorer and of lower status. The skin is lighter than in the east and at times shows a yellowish tinge. The eyes are brown, green-brown, and blue, the latter usually with brown hair of the lighter shades. The stature is lower and the Dinaric face is absent, but faces of Laplander type are common. There is also a number of indeterminate types, some of which approach the 'alpine' type, though with lighter complexions. The people are much less healthy than the Huculs. Tuberculosis is common, in some villages rising so high as forty per cent among the children. Adults without goitre are rarely seen.

Ancient Jewelry from Yasin. — Sir Aurel Stein figures and describes in the *Indian Antiquary* for June a collection of ancient jewelry from the once cultivated tract of the Dasht-i-Tana in the Hindu Kush valley of Yasin in the Gilgit Agency. The find was made by villagers while digging up a small mound, and no particulars of the circumstances are available. As most of the objects were of gold, it is probable that 'specimens' only were given up. Comparison with objects cleared from burial deposits in 1913 suggests a similar provenance. Of the Yasin objects, two provide more definite chronological evidence than those found elsewhere. Of these two objects, one is a small bronze figure of a Bhodisattva 3¼ inches high and 2¼ inches broad at the base. The figure is seated and the right hand is held, palm outwards, at the level of the knee, while the left holds some indistinguishable object. The metal is too corroded to allow details of features or dress to be made out; but around the neck is an ornamental band or chain and the folds of the drapery are disposed in the Græco-Buddhist style of Gandhāra. The lotus seat is of a style which persists in Buddhist sculpture from the early centuries of our era down to a late period. This little figure may be an import from outside, as is certainly the second object, an intaglio set in the bezel of a fine gold ring. It is cut in an onyx-like stone, much crackled by exposure to great heat. It represents a helmeted male head which is of a late Hellenistic or Roman style of workmanship. Similar intaglios from Khotan and other parts of Chinese Turkestan have been dated at second-third century A.D. The number of such seal stones found in Central Asia and north-west India suggests that they were a frequent article of import from the west.

Birds of Guatemala.—The bird-life of this limited area, lying between two distinct zoogeographical regions, the nearctic and the neotropical, is wonderfully rich in racial forms. The American Museum of Natural History possesses collections of birds made there by Austin Paul Smith and A. W. Anthony, excelled only by the Salvin-Godman collection in the British Museum, and these collections have been reported upon by Ludlow Griscom in a monograph of 439 pages (*Bull. Amer. Mus. Nat. Hist.*, vol. 64, 1932). The wealth of the bird-life of the area is traceable to a number of factors, of which the chief are the antiquity of the country and its position between the two zoogeographical regions of the New World. To the first is due the survival of some elements of a once rich pre-glacial avifauna; to the second the influx of fresh contingents of birds from the north during the Pleistocene period, and of southern tropical elements during post-glacial time. These various elements in the bird-life have been so modified by time, in association with diverse topography, much local isolation, and half a dozen different climates, as to produce the 736 species and subspecies recorded in this monograph. The author, refusing to commit himself, leaves the reader to decide whether the compelling factors in this evolution were the latent potencies in the germ plasm or the stresses of time and change of environment, but he reminds us that the outcome of systematic and zoogeographical studies has been to show that, granted variation is limited by the latent potencies in the germ plasm, such potencies are of no value with the great majority of birds unless subjected to environmental stresses. Where environmental stresses are many and diverse, there is extraordinary diversity in the bird fauna, as in Guatemala or in Colombia or Ecuador; where environmental stresses are few or too severe, there is a relatively uniform and poverty-stricken bird fauna, as in New England, which is just recovering from the glacial epoch.

Free-living Nematodes of the Belgian Coast.—This, the first account of the free-living nematodes of the Belgian coast, is based on the collections in the Natural History Museum in Brussels and on material collected by dredge or net from twelve stations. The authors (J. H. S. Stekhoven, jr., and W. Adam, in *Mém. Mus Roy. d'Hist. Nat. de Belgique*, No. 49; 1931) direct particular attention to the material from the surface of *Alcyonium* and from oyster beds. The colonies of *Alcyonium* dredged at two of the stations were covered with a rather thick layer of fibrous substance (probably the mucus coagulated on fixation), on the inner surface of which nematodes were present in large numbers and in almost identical proportions in both cases. Oyster beds are favourable for those nematodes which are detritus feeders, and a ship's hull with its rich fauna of hydroids afforded excellent conditions for an opulent nematode fauna. Twenty-six genera, including twenty-seven species, eight of which are new, are recorded. The geographical distribution of each species is stated, and notes on the characters, including the Cobb formula, are given for most of them. While these nematodes are essentially marine, some of the species are capable of penetrating into waters of lower salinity.

Mosaic Disease of the Bean.—"Investigations in the Mosaic Disease of Bean (*Phaseolus vulgaris* L)", by Ray Nelson (*Michigan State College Tech. Bull.*, No. 118; 1932), gives the results of very extensive studies

into the behaviour of the virus diseases of the runner bean. The malady known as mosaic has a world-wide distribution, and is one of the few viruses which are transmitted through the seed. Many aspects of the problem have been studied, but great efforts were directed towards cultivating the virus or finding a causal parasite. A coccoid body was isolated from diseased tissue and appeared to have a close association with mosaic, but would not reproduce this disease when inoculated on to healthy plants. Rugose mosaic, a virus disease distinct from ordinary mosaic, has also been studied.

Geology of South-Eastern Manitoba.—*Memoir* 169 of the Geological Survey of Canada, by J. F. Wright (1932, pp. 150 and map), is devoted to the geology and mineral deposits of the area between the south end of Lake Winnipeg and the Lake of the Woods, just east of the junction of the Canadian Shield with the Great Plains. Apart from Quaternary deposits and the nearly horizontal early Palæozoic strata which overlap the crystalline complex of the Shield, the rocks are of ancient Pre-Cambrian age, and consist (*a*) of an assemblage of sedimentary and volcanic strata and their metamorphic equivalents intruded upon by (*b*) a widespread series of igneous rocks ranging from peridotite to granite. The supercrustal assemblage is known as the Rice Lake Series, and is divisible into the Manigotagan phase of sedimentation (fine-grained arenaceous and argillaceous deposits); the Beresford Lake phase of volcanic conditions (basalt, andesite, dacite, and rhyolite, now largely altered to green-schists, with greywackes, chert, and iron-bearing formations); and the Wanipigow phase of renewed sedimentation (greywacke, arkose, quartzite, and slate). The series is typical of geosynclinal conditions and is lithologically similar to the Couchiching and Keewatin. The deep-seated intrusives include peridotite and gabbro, associated with nickel-copper sulphides, and both are known to be earlier than the granodiorites and granites. The end phases of granite invasion are represented by microcline- and albite-pegmatites. Tin and lithium deposits occur with the latter, and one of the albite-pegmatites contains uraninite, which H. V. Ellsworth finds to have a lead-ratio of 0·260 to 0·265 (*Amer. Min.*, 1931, p. 569). This is the oldest mineral yet known, and it is of interest that the conglomerates of the Rice Lake Series contain pebbles of a still older granite.

Cavities in the New Jersey Traps.—The crysta cavities in the Triassic trap rocks of the New Jersey zeolite region have long excited the interest of mineralogists. A detailed study of the phenomena has been made by W. T. Schaller (*Bull.* 832, U.S. Geological Survey, 1932, pp. 90). The cavities occur in an altered basalt that as lava flowed into pre-existing lakes occupying depressed areas in which glauberite and other saline minerals had accumulated. Where the lava poured over dry Triassic shale it contains no cavities. The mineral history is as follows: (1) Solidification of basalt; (2) formation of anhydrite and glauberite derived from the lake waters; (3) formation of quartz, albite, etc., replacing the lava; (4) solution of glauberite leaving *rhombic cavities*, precipitation of prehnite, datolite, pectolite, etc., and solution of anhydrite leaving *rectangular cavities*; (5) zeolite formation from lime and soda supplied by the solution of the saline minerals; (6) deposition of calcite and changing of remaining anhydrite to gypsum and thaumasite. In addition to the two main types of cavities mentioned above, there are also lamellar types representing anhydrite and possibly calcite and babingtonite, and a miscellaneous series after apophyllite, quartz, calcite, natrolite, pectolite, and other minerals. Although no glauberite now remains in the region, the rhombic cavities sometimes contain pseudomorphs in quartz the measured forms of which prove to be identical with those of glauberite.

Rainfall of Sumatra.—Dr. J. Boerema has published detailed monthly and annual maps of the rainfall of Java and Madura (*K. Mag. Met. Obs. Batavia*, Verhand. 14, vol. 2). Similar information is now available for Sumatra (Verhand. 24, vol. 2). The figures relating to rainfall are derived from observations extending over at least five of the fifty years 1879–1928. In a few instances they refer to the whole fifty years. Anyone making use of these statistics should bear in mind the great difficulty of securing accurate and comparable figures from a large number of voluntary observers, and should also note that figures based on periods of varying length are not strictly intercomparable, even if free from error, owing to differences in the general character of the weather in the different periods—the 'errors of sampling' of mathematical statistics. In spite of these difficulties, the material is obviously of great economic importance, besides being a big contribution to climatology. Sumatra is famous for its luxuriant vegetation. Except on the higher mountains, the mean temperature of every month is high, and bearing this fact in mind, an inspection of the rainfall statistics provides a sufficient explanation of this luxuriance. It is significant that on the map of annual rainfall no tint is provided to represent a rainfall anywhere near so low as London's 600 odd millimetres. On a part of the mountain chain that lies not far from Padang, on the west coast, the annual total is shown as more than 7000 mm. (23 ft.), and there is an almost equally wet region towards the north end of the island. If more detailed information is required, the reader must refer to Verhand. No. 24, vol. 1, which contains tables of rainfall relating to 3293 stations in the Netherlands Indies, for the period 1879–1928 or a portion of that period. This volume includes the data for Sumatra.

Thermal Expansion of Bismuth.—An investigation of the thermal expansion of a bismuth single crystal has been made by A. Goetz and R. C. Hergenrother (*Phys. Rev.*, June 1), which is of importance in bringing out the difference between the macroscopic and microscopic properties of solids. The expansion was measured by two methods. The first, which has been carried out several times for this substance, was similar to the standard macroscopic work of Roberts. The second consisted in examining the temperature shift of an X-ray beam, when reflected from the (111) plane in a modified Siegbahn apparatus, and tells how the crystal lattice changes in size with change in temperature. The results of the latter determinations show that an empirical relation, due to Grüneisen, which states that expansion coefficient and specific heat bear a constant ratio to one another, was accurately satisfied up to almost the melting point, whereas a departure from this, outside the range of experimental error, occurs if the macroscopic expansion coefficients are used. The interpretation of the discrepancy, based on the assumption that there is an amorphous component in the crystal as well as the component with a regular lattice, is that the relative amount of the former increases with increase in temperature, but little, if any, obvious advance has even now been made towards the outstanding problem of why a pure substance melts sharply.

Stellar Structure.—A review of the recent work of the constitution of the stars was given by Prof. E. A.

Milne in a lecture on "Some Aspects of Stellar Structure", delivered before a joint meeting of the University of Durham Philosophical Society and the Newcastle-upon-Tyne Astronomical Society on March 4, an abstract of which has just been published (*Proc. Univ. Durham Phil. Soc.*, vol. 9, pt. 1). The lecture gives a descriptive account of the properties of the 'two phase' stellar model and the conclusions to be drawn from them. This model consists of a degenerate spherical core, approximately isothermal, surrounded by a gaseous envelope of constant opacity. The essential variables taken are L/M, the ratio of the luminosity of the configuration to its mass, and r_1/r_2, the ratio of the core radius to that of the whole configuration. The relations between these two variables, as worked out mathematically, are exhibited as a series of curves connecting L/M with r_1/r_2 for each constant M. The curves show that for certain values of L/M and constant M there are two distinct configurations possible, corresponding generally with the phenomenon of the rearranged 'Russell diagram'. Certain of the curves of high mass show a position where dL/dr_1 is infinite. This is the limiting position giving a maximum L for that particular mass. It is shown that at this point the core radius is indefinite and pulsations are likely to occur, suggesting an explanation of the cepheid variables, which thus appear only in certain classes of configurations. The curves also exhibit the possibility of discontinuous changes. During one of these the core radius increases cataclysmically and the external radius decreases cataclysmically, with the consequent evolution of energy. The phenomena resemble those of a nova outburst. The curves of low mass and certain portions of those of high mass yield an approximately linear relation between L/M and M for corresponding configurations. They also throw light upon the giantism of some stars, the dense characters of the nuclei of planetary nebulæ, and the general relationship of dense stars to non-dense stars. The complete mathematical investigation has since appeared in *Mon. Not. R.A.S.*, vol. 92, No. 7.

Oxidations with Selenium Dioxide.—Riley, Morley, and Friend (*J. Chem. Soc.*, June) show that selenium dioxide is capable of oxidising acetone to methylglyoxal and acetophenone to phenylglyoxal on heating, the selenium dioxide being reduced to selenium. Similar reactions giving other derivatives of glyoxal were carried out. A methylene group adjacent to the carbonyl group of an aldehyde is readily oxidised to carbonyl by selenium dioxide and the preparation of glyoxal from acetaldehyde according to the reaction

$$CH_3CHO + SeO_2 = (CHO)_2 + H_2O + Se$$

may be caused to proceed almost quantitatively. In some cases the reaction may be carried out by passing the vapour of the substance over selenium dioxide in a heated tube. The reactions show that selenium dioxide has a specific oxidising action on aldehydes and ketones of various types, whereby 1 : 2 diketones and aldoketones are conveniently obtained in quantity, compounds which contain a methylene group activated by proximity to a negative group being specifically oxidised at reasonably low temperatures.

Astronomical Topics

A New Algol-Variable in Andromeda.—*Astr. Nach.* 5877 contains a paper on this star by its discoverer, Herr K. Lassovszky. He found it on a plate that he took at Neubabelsberg on April 27, 1931; its position for the equinox of 1855 is $23^h\ 42^m\ 18^s$, N. Decl. 44° 58·4′, and its designation 381, 1931 Andromeda. He took a series of plates on fifteen nights between July 23 and Aug. 21, 1931, to study the light curve; the period is $0{\cdot}79365^d$ or about 19 hours. The magnitude is 11·26 at maximum, and falls to 11·87 at minimum; the duration of eclipse is $0{\cdot}160^d$; the light-curve appears pointed at minimum, showing that the eclipses are not annular, as in that case the curve is flat at minimum. The observations do not show any trace of a secondary minimum, such as occurs in Algol; it may be concluded that the eclipsing star is much fainter than the other. The star is less than 2° distant from "Selected Area No. 43"; Herr Lassovszky utilised this fact to obtain the magnitudes of his comparison stars by comparing them with stars in that well-surveyed region. It reflects credit on a single observer to have both discovered the star's variability and deduced an accurate light-curve in the course of a year.

Astronomical Notes for August.—Mercury is well placed as a morning star at the end of the month, being in elongation on Sept. 3. Venus is conspicuous as a morning star, being at its greatest brilliance on Aug. 5. Jupiter and Neptune are both near the sun; the former is in conjunction on Aug. 26; it will be about 5° from the eclipsed sun on Aug. 31. Neptune will be less than a degree from the eclipsed sun, and may be recorded on some of the coronal plates. A small partial eclipse at sunset will be visible from parts of Galway and Mayo and the islands of Skye and Lewis. Prof. S. Chapman has pointed out that the British Isles are within the region in which effects of the eclipse on wireless transmission may be looked for. Saturn passed opposition on July 24, and is therefore visible for most of the night; but its south declination of 20° makes observation difficult. Uranus is approaching opposition, and may be observed after midnight.

There will be an occultation of the Pleiades on the morning of Aug. 24; disappearances of three stars at the bright limb occur at $1^h\ 20^m$, $1^h\ 41^m$, $1^h\ 50^m$; the times and angles of reappearance of five stars at the dark limb are $2^h\ 6^m$, 198°; $2^h\ 25^m$, 242°; $2^h\ 44^m$, 272°; $3^h\ 1^m$, 227°; $3^h\ 10^m$, 276°. The angles are reckoned from north through east and south.

The Perseid meteors should be looked for about Aug. 10, especially after midnight, as Perseus is then higher; the moon sets at $10^h\ 30^m$ p.m. on Aug. 10.

Newman's comet may be observed with moderate telescopes; the following ephemeris for 0^h is from *Harvard Card* 229:

	R.A.	N. Decl.
Aug. 1	$14^h\ 51^m\ 42^s$	26° 5′
5	14 51 7	27 2
9	14 51 6	27 54
13	14 51 38	28 42
17	14 52 41	29 28
21	14 54 14	30 11
25	14 56 16	30 53
29	14 58 46	31 34

The comet has been observed to throw off nebulous objects; its neighbourhood should therefore be examined.

A minimum of Algol occurs at $0^h\ 5^m$ on Aug. 7.

Add one hour to all times to reduce to Summer Time.

Geology and Archæology of Kharga Oasis, Egypt*

THE second season's exploration of the Prehistoric Research Expedition of the Royal Anthropological Institute to Kharga Oasis, Egypt, under Miss G. Caton-Thompson and Miss E. Gardner, was devoted to the further examination of the 'fossil' or dead springs of Pleistocene age, discovered in the first season, which promised a fruitful line of inquiry in palæolithic stratigraphy and palæo-climatic conditions, and the dating of the tufa deposits and sheets of gravel on the eastern scarp.

On the scarp, the oldest deposit of the 'drift' sequence is a massive crystalline tufa, here named the Plateau Tufa to distinguish it from the later Wadi Tufas. It has no fauna or human evidence and provisionally is placed at Plio-Pleistocene. This was followed by a period of great erosion, causing the formation of transverse and longitudinal valleys, again without cultural evidence. The next stage was the filling in of these valleys in their upper reaches with accumulations of angular breccia, now standing in places as high as 25 metres. This represents a long dry period. On its passing, lower palæolithic man appears on the scene. Rain encouraged vegetation, and the earliest of the Wadi Tufas was formed on the breccia. Unrolled Acheulean tools have been found, thus dating a tufa deposit in Egypt for the first time. The formation of the plateau gravels belongs to this phase. They also have yielded Acheulean tools.

The fifth episode bridges lower and middle palæolithic. An unrolled Acheuleo-Levallois industry has been found in situ sub-tufa. The plateau gravels were eroded and spread in a secondary sheet ("Exogyra gravels"), also containing a mixed Acheulean and Levallois industry.

The middle palæolithic stage is one of considerable but ultimately decreasing rainfall. Another tufa forms over silts and gravels and the formation of the modern drainage system begins. These tufas also are dated by tool floors beneath them. The implements are the products of a tortoise core industry; but it includes so many forms unrecognised in Mousterian industry that it has been named provisionally "Pre-Sebilian". The mode of formation of the tufa is found to be the ponding up of the primary valleys. Pre-Sebilian man frequented the shores of the pools, as is indicated by the collections of tools made from sub-tufa silts.

In the following period the streams grow weaker, and terrace gravels are formed, dual and triple. In an upper terrace were found Pre-Sebilian tools, and on it, in a bed of silt 0·40 m. in thickness, an Aterian flaking site, indicating a lower upper palæolithic date for the Aterian. Here the physiographic sequence ends, and man abandoned the wadis and gravel plateaux surrounding them for the Libyan plateaux where occur the Capsian and Capsian-Tardenoisean sites.

The great flint mines discovered in the first season were re-examined and found to be purely of neolithic age, and not of mixed age as was believed at first.

On the depression floor a magnificent collection of five hundred Acheulean hand-axes was discovered. These were in an area not exceeding 30 sq. metres. and were in mint condition, but glazed. The glaze was certainly produced by sandy waters in a spring and was not due to desert exposure. The hand-axe types are remarkably varied, normally lanceolate forms predominating. With them were their flake industry and cores. In size the axes range from 21 cm. to miniatures less than 4 cm.

A large fossil spring was excavated to a depth of 9 metres. Interstratified gravels, the lowest at a depth of 4 metres, yielded an abundant tortoise core industry which is not Aterian, but its relation to the Levalloisean and Pre-Sebilian on the scarp is not yet clear.

A Capso-Tardenoisean surface site was discovered on the sandrock deposit sealing a fossil spring. The formation of these sandrocks is the final stage in the history of all the fossil springs, and it may, therefore, be inferred that desert conditions obtained prior to the date provided by the surface site.

The cultural elements of the Kharga neolithic were identified. Hearths were discovered in the capping sandrock. Little holes were pierced in the capping sandrock for the supply of water. The curious stone-capped mounds, standing three to four feet high, have been examined and discovered to be the remains of hearths which had originally been holes sunk in the soil and lined with flat pieces of limestone. Since the hearths were abandoned, desert erosion had lowered the ground level. When the stone lining of the hearths was reached, this acted as a protection to the underlying ground and prevented further erosion, so that in course of time the hearth survived as a mound. This indicates a lowering of the desert surface by as much as 6 ft. since neolithic times.

In the matter of general conclusions, it would appear that neither Kharga nor the Fayum is of fluviatile origin, as has been suggested, and earlier views as to the non-existence of a lake in the floor of the depression are confirmed. The deposits formerly attributed to a lacustrine agency are wind-borne loess-like material. There is no dating for this arid period, but it appears to be pre-human.

After neolithic times the Wadi appears to have become uninhabitable and not restored to prosperity until Persian engineers tapped the artesian water bed.

* "The Royal Anthropological Institute's Prehistoric Expedition to Kharga Oasis, Egypt", by Miss G. Caton-Thompson, *Man*, June 1932.

Spectrographic Analysis

BULLETINS recently issued by Messrs. Adam Hilger, Ltd., give particulars of recent advances in methods of spectrographic analysis and in apparatus. The first, No. 168, describes a method of analysis originated by Judd Lewis (*Chemistry and Industry*, **51**, 271-274; 1932) and a range of salts, mixtures called "ratio mixtures", and solutions of high chemical purity under the name of "specpure substances", for use in that scheme of analysis. The method, essentially, is for the determination of elements present in minute proportions, and it applies to all the metals, together with the non-metals silicon, boron, phosphorus, and arsenic. The major constituents having been determined by ordinary chemical analysis, each minor constituent is determined approximately as a ratio of one or other of the major constituents by comparison of the spectrograms of the sample containing the metals in the form of sulphates with spectrograms of the specpure ratio mixtures. Finally, from the data thus obtained, the substance is synthesised by means of the ratio solutions, and a spectrographic comparison is made between the specimen and its synthesised counterpart.

According to the scheme, the specimen and the ratio substances are so prepared that the comparisons are conducted throughout with chemically similar sub-

stances. Lewis has worked chiefly with the electric arc, using electrodes of copper, but it is claimed that the principles involved are applicable to spark and flame spectra, and that the analysis can be made on as little as a milligram of metal, mineral, or ashes of animal or vegetable tissues; further, that good approximate results may be obtained in ordinary practice with no more than average experience.

The ratio mixtures are an extension of the well-known H. S. Brand metals and the R.U. powders detailed in Hilger's booklet No. 94/5. This method, evidently, marks a distinct advance in spectrographic analysis, and it should help to extend the use of the spectrograph in chemical laboratories, in which it is now too rarely employed.

Bulletin No. 169 describes the Müller-Hilger Universal Double Monochromator, which, embodying the principle of double spectroscopic purification, is especially suitable for producing powerful radiations which are strictly monochromatic. The form of construction is original and is the subject of several patents in Great Britain and abroad. Both wave-length setting and focusing are effected simultaneously for the whole instrument by means of a single drum engraved to read in wave-lengths. The optical system is crystallised quartz, and the range of the standard instrument extends from wave-length 0·185 μ in the ultra-violet to 4·0 μ in the infra-red. The relative aperture varies from $F/4$ for 0·185 μ to $F/5{\cdot}8$ for 4·0 μ. The operative beams are axial and the lenses corrected by means of Hilger's interferometers; so that not only are the isolated parts of the spectrum in accurate focus but also every line throughout the spectrum is of good definition.

Messrs. Adam Hilger, Ltd., have just opened new offices and laboratories at 98 King's Road, adjoining their works. The extensions consist of 4400 sq. ft. of office space and 3400 sq. ft. of additional laboratory space, providing ample room for departments which recently have been much congested. The optical glass department will now be housed in the space formerly occupied by the offices. There are at present seventeen principal sections in the works, with eleven chief technicians and four heads of departments.

William John Macquorn Rankine

IN an oration delivered in the University of Glasgow on June 15 at a meeting "in Commemoration of Benefactors", Sir James Henderson paid a tribute to the memory of Macquorn Rankine, who occupied the chair of engineering from 1855 until his death in 1872. Rankine was once described as "the first really powerful thinker in this country to bring the highest mathematical resources to bear on engineering subjects", while the late Prof. Archibald Barr said that he ranked as "the greatest Professor of Applied Science who has yet appeared".

There is a sketch of Rankine's life in the "Dictionary of National Biography", and another by Tait is included in Rankine's "Miscellaneous Scientific Papers", while an obituary notice by Mayer appeared in NATURE of Jan. 16, 1873, but there is still no complete biography of him. In view of this, Sir James Henderson's tribute, printed in full in the *Engineer* for June 24, will be read with interest.

Rankine, who was born on July 5, 1820, died on Dec. 24, 1872, at the early age of fifty-two years, having, however, accomplished an amount of work seldom surpassed by any one. His works on "The Steam Engine" (1859), "Applied Mechanics" (1859), "Civil Engineering" (1862), "Machinery and Millwork" (1869) and other subjects are among the classics of engineering, while to these must be added many scores of scientific memoirs. As a boy of fourteen he read Newton's "Principia" in the original Latin, and at sixteen gained a medal for an essay on "The Undulating Theory of Light"; and in spite of his being trained and his experience as a civil engineer, mathematical physics always made the strongest appeal to him. His work in this direction claimed the chief part of Sir James Henderson's address.

Up to the year 1848, said Sir James, Rankine seems to have been continuously employed as a civil engineer in various schemes, but in that year there occurred a sudden change which it is impossible to explain. The practical civil engineer suddenly becomes the theoretical physicist, and from 1848 until he became professor in 1855, Rankine's energies seem to have been devoted almost entirely to those researches in molecular physics which gained for him the fellowship of the Royal Society in 1853. His early work on this subject was followed by researches in elasticity, hydrodynamics, and thermodynamics. Rankine's contribution to thermodynamics Prof. Tait described as his greatest work. He laid the foundation of the mathematical science as it is known to-day; he applied the second law to heat engines of all kinds, steam engines, air engines, and explosive engines, while in steam engines he introduced the cycle now known as the Rankine-Clausius cycle, which is used as the ideal for engines and refrigerators using vapours as the working substance, and he pointed out that this law is only a particular case of a wider law applicable to all sciences.

At the conclusion of his address, Sir James endeavoured to recall what manner of man Rankine was, and his remarks helped to emphasise the regret that none of Rankine's contemporaries had written his life.

Utilisation of Empire Timbers

AT a recent meeting of the Royal Society of Arts, Maj. J. R. Cosgrove of the Forest Products Research Laboratory read a paper entitled "Empire Timbers, with special reference to their Uses for Furniture and Decoration" (*J. Roy. Soc. Arts*, vol. 80, No. 4136, Feb. 26, 1932). In introducing the lecturer, the chairman, Sir Richard Allison, said that the lecture was opportune, since "in all directions British citizens are faced with the demand to 'Buy British'. With such a commodity as timber apparently much propaganda is necessary to bring home to potential users the possibilities of Empire supplies, and also the beauties of the many woods available for decorative and furniture purposes." He added that for several years past the architects at the Office of Works have concentrated entirely on Empire hardwoods, having satisfied themselves that all their requirements in connexion with buildings can be adequately met by Empire supplies. It is most satisfactory to have such a declaration publicly made, and it would appear to give force to the opinion recently expressed in these columns that the forest services of the Empire require strengthening rather than curtailment, in order to be able to give an answer to the question as to whether supplies of the, at present, mostly unknown timbers could be extracted in sufficient amounts and placed on the markets at an economic price. Without this certainty, it will remain difficult to overcome old-established preferences.

Maj. Cosgrove correctly said that the past few years seem to have caused a profound change of outlook in the people of the British Empire, and with the appeal

increasingly made to support Empire industries he proposed to discuss certain of the timbers obtainable within the Empire, either from home or overseas, which in some form or other may be used for decorative purposes and in the making of furniture. An approximate calculation showed that the value of timber, excluding pulpwood, entering the British market, amounts annually to £40,000,000–£45,000,000, of which about 30 per cent represents hardwoods, much of which goes into utility and decorative work. Of the totals, therefore, of £30,000,000 for softwoods and £12,000,000 for hardwoods, the Empire's share at present works out to somewhat less than 10 per cent for softwoods and less than 30 per cent of the hardwoods; of which latter, however, a large amount, in value at least, is for teak from Burma. The wide use and popularity of foreign timbers is attributed by Maj. Cosgrove to a number of causes—such as the volume in which supplies have been available, their suitability and relative cheapness, the preparation which has been bestowed upon them in the form of careful manufacture, grading, and conditioning, and so forth. This implies that the timbers in use have an assured position, and that users will as a rule purchase them from descriptions alone and usually without preliminary inspection.

After discussing briefly the value of research work, Maj. Cosgrove enumerated some of the hardwoods, from both the British Empire and foreign sources, which are well known on the markets. He then discussed the possibilities of timbers which are particularly suitable for decoration and furniture from Great Britain, India, British North Borneo, Australia, New Zealand, British West Africa, British Guiana, West Indies, British Honduras, and Canada.

Advances in Stereo-Chemistry

THE sixth Messel Memorial Lecture was delivered before members of the Society of Chemical Industry at Nottingham on July 14 by Sir William Pope. Reviewing "Forty Years of Stereo-Chemistry", Sir William Pope traced the important developments of the present century in this branch of organic chemistry, which about 1890 was comparatively dormant, and had largely remained so since the work of Pasteur, van 't Hoff, and Le Bel. Development recommenced with the introduction of an improved technique for the resolution of synthetic mixtures or racemic compounds which followed from the discovery of the sulphonic acids of camphor and their halogen derivatives. The further demonstration that optical activity may be associated with the presence in the molecule of asymmetric atoms of other elements such as sulphur, tin, silicon, phosphorus, as well as the verification among ethylene derivatives of van 't Hoff's prediction of the optical activity of allene derivatives of the type *abC*:*C*:*Ccd*, led chemists generally to realise that the chemical molecule is spread out in three-dimensional space, and prompted subsequent attempts to ascertain the way in which the properties of compounds are influenced by the shape of the molecules.

Sir William Pope referred to the way in which the conception of the asymmetric carbon atom has tended to divert attention from the conditions of mirror-image isomerism defined by Pasteur. The asymmetric carbon atom covers only one, though the commonest, class of mirror-image isomerism. The fundamental condition is that the molecular configuration may possess any elements of geometrical symmetry except a centre of symmetry or a plane of direct symmetry. Thus the molecular configuration of an optically active compound need not be asymmetric or entirely devoid of geometrical symmetry. In the Hantzsch and Werner theory of the configuration of the eximes, illustrated by Mills, or the optical activity and mirror-image isomerism among diphenyl derivatives, discovered by Kenner, are other examples of the way in which the whole of organic chemistry has acquired a stereo-chemical aspect.

While our knowledge of certain branches of stereochemistry is rapidly advancing, the space configuration of the benzene ring and of aromatic compounds in general remains an unsolved problem. Similarly, our knowledge of the combination to a homogeneous crystalline compound of substances with mirror-image configurations is developing but slowly, and little attention has been given to the question of racemic combination between dextro- and laevo-isomerides in the liquid state. Although as yet the novel and powerful methods of modern physics for determining the arrangement of the atoms or even of the components of atoms in solid, liquid, or even gaseous substances, such as X-ray diffraction determinations, the measurement of dipole moments, or the quantitative study of the behaviour of films only a few molecules in thickness, have merely enabled us to confirm the structures assigned on chemical grounds, Sir William Pope suggested that we may be on the verge of fresh developments which will convert the new physical methods into much more searching weapons for the determination of molecular configuration than any formerly at our disposal.

University and Educational Intelligence

CAMBRIDGE.—Applications for the Benn W. Levy research studentship in biochemistry should be addressed to Sir Frederick Gowland Hopkins at the School of Biochemistry before Aug. 1.

A pension of £540 a year has been granted to Sir Joseph Larmor on his retirement from the Lucasian professorship of mathematics, and to Mr. H. A. Roberts on his retirement from the secretaryship of the Appointments Board.

At Clare College, Mr. E. T. C. Spooner, University demonstrator in pathology, has been elected to an official fellowship.

At King's College, E. S. Shire has been elected to an R. J. Smith studentship, and A. G. D. Watson and D. Purdie to Harold Fry studentships.

Dr. P. A. M. Dirac has been elected Lucasian professor of mathematics in succession to Sir Joseph Larmor, who retires on Sept. 30.

EDINBURGH.—At a meeting of the University Court on July 18, Mr. W. L. Edge, fellow of Trinity College, Cambridge, was appointed lecturer in the Department of Mathematics, in succession to Dr. E. L. Ince, who has resigned.

The Cameron prize in practical therapeutics has been awarded to Prof. Edward Mellanby, professor of pharmacology, University of Sheffield, in recognition of his discoveries regarding the therapeutic actions of the fat-soluble vitamins.

LONDON.—The following appointments to University readerships have been made, to take effect from Oct. 1: experimental pathology (Lister Institute of Preventive Medicine), Dr. E. W. Hurst, formerly pathologist to the Millbank Research Fund at the Lister Institute; mathematics (Imperial College—Royal College of Science), Dr. W. H. McCrea, lecturer in mathematics in the University of Edinburgh; pathological chemistry (the Cancer Hospital), Dr. J. W. Cook, research chemist in the Research Institute of the Cancer Hospital. The title of University reader was conferred on the following in respect of posts held at the colleges indicated: geography, Dr. Hilda Rodwell Ormsby (London School of Economics); civil engineering,

Mr. John Purser (Imperial College—City and Guilds College) and Mr. M. K. Rice-Oxley (Imperial College—City and Guilds College); mechanical engineering, Dr. J. V. Howard (Imperial College—City and Guilds College) and Dr. S. Livingston Smith (Imperial College—City and Guilds College).

WALES.—At a meeting of the University Court on July 20, reference was made by the pro-chancellor to the very grave financial position of the University, which has arisen owing to the decrease in the contributions of local authorities since the passing of the Derating Act. Unless there is a favourable outcome to the negotiations which are now proceeding, the University will suffer a reduction in income of about £10,000 a year.

The Council of the Welsh National School of Medicine has appointed Sir Ewen J. Maclean to be an emeritus professor.

IN connexion with the Geneva Institute of International Relations, a conference on Training for World Citizenship will be held at the Institute on Aug. 19–23. Particulars can be obtained from the Secretary, Education Committee, League of Nations Union, 15 Grosvenor Crescent, London, S.W.1.

THE sixth International Conference of University Women is being held at Edinburgh. The Conference was opened on July 27 and will continue until Aug. 4. Included among the lectures being given in connexion with the Conference is one by Dr. Johanna Westerdyk on "Epidemics of Plant Diseases", and another by Mme. M. L. Puech on "Intellectual Co-operation". For the first time, the group discussion method will be introduced, the subject being "Does the University offer to the Modern Woman the Training needed to fit her for Life?": the discussion will be opened by Dr. Aurelia H. Reinhardt.

EDUCATION for commerce was discussed at a meeting of the Royal Society of Arts under the presidency of Sir Francis Goodenough on April 27. A full account of the lecture by Mr. H. Ramsbotham, Parliamentary Secretary to the Board of Education, which preceded the discussion, and of the remarks by a number of authorities, eminent in business and education, who took part in it, has now been published (*J. Roy. Soc. Arts*, June 17). Mr. Ramsbotham emphasised the imperative necessity of co-operation between employers and teachers in connexion with the framing of curricula, recruitment for employment in commerce, and part-time further education of employees. Now that so large a proportion of the younger generation, who would in former times have gone into the factory or the office at the age of fourteen years, remain in school for another two years, it is of vital importance that the needs of the factory and office should not be ignored by the schools. In the course of the discussion, many practical problems were dealt with and elucidated by reference to particular instances. Mr. Chorlton referred to effective training methods in use on the continent, especially Czechoslovakia, where the number of part-time day students of 16-20 years of age is thirtyfold greater in proportion to population than in Great Britain. Mr. Harold Sanderson described a successful experiment in the Burslem (Potteries) district in secondary education with an artistic bias. Miss Ford, H.M. Staff Inspector of Schools, suggested that American experience in child guidance and vocational guidance showed that we do not in Great Britain devote enough attention to detailed systematic examination of children to find out what their aptitudes are. Other speakers dwelt on the necessity for a better understanding on the part of university authorities of the qualifications appropriate for employment in commerce.

Calendar of Geographical Exploration

July 31, 1908.—Interior of New Guinea

D. Mackay and W. S. Little landed in New Guinea and explored the Upper Purari River. They suggested that coal existed in the interior of the island, and as a result Staniforth Smith in 1910–11 opened up for the first time a large area north-west of the Gulf of Papua and east of the basin of the Fly River.

Aug. 1, 1862.—The Kara Sea

P. von Krusenstern, jr., started from the Pechora River on his second attempt to reach the Kara Sea. His boat became fixed in the ice near Yugor Shar and drifted across to the east coast of the Kara Sea, his narrative forming the first complete sketch of a journey from west to east of that sea. He and his men had a series of hairbreadth escapes: their vessel was nipped in an icefield and eventually had to be abandoned. They made their way across the ice, sometimes leaping on to pieces of drift ice which had to be towed by boathooks, but ultimately reaching land and travelling in reindeer sledges to Obdorsk. A curious incident was the attempt of six walruses to accompany them on to a piece of drift ice.

Aug. 2, 1904.—Tibet and the Mustagh Pass

Sir Francis Younghusband reached Lhasa on a political embassy. On the return journey, the Brahmaputra from Shigatse to its source, the Sutlej from its source to the borders of India, and the Gartok branch of the Indus were surveyed by members of the party—a most important contribution to the geography of south and south-west Tibet. In 1886, Younghusband and H. E. M. James set out from Manchuria for India, during which journey they discovered and crossed the Mustagh Pass in 1887. Younghusband's work markedly extended the amount of accurately surveyed area in these regions; he also proved that the Mustagh is the true water parting west of the Tibetan plateau.

Aug. 3, 1868.—Scientific Exploration of China

Baron F. von Richthofen sailed from San Francisco for China, where he carried out his classic survey of that country. In 1859 he had accompanied a Prussian diplomatic mission as geologist, visited Ceylon, Japan, Formosa, the Philippines, and Java, and made an overland expedition from Bangkok to Moulmein. Unfortunately, his records and collections on this journey were lost. In 1877–85 he published three volumes and an atlas dealing with the geology and geography of China, including a notable study of the loess regions. He directed attention to the coalfields of Shantung, to the importance of Kiaochow as a port, and to many other possibilities of economic development. Between 1868 and 1872 he made seven expeditions into the interior of China, visiting, among other regions, Shantung and South Manchuria, central China, Chih-li, and Szechwan.

Aug. 4, 1482.—Mouth of the Congo

Circumstantial evidence points to this as the probable date on which Diego Cam or Cão discovered the mouth of the Congo River. Cam was the first explorer to carry stone pillars to mark newly discovered points, instead of relying on wooden crosses or carved trees. He put up four pillars altogether, two on his first and two on his second voyage. Fragments of the pillar he set up on Shark point to commemorate his discovery of the Congo River still

remain. Cam thence sailed south along the Angola coast and erected a second pillar at Cape Santa Maria in 13° 26′ S. On his second voyage (1485–86) he reached Cape Cross in 21° 50′ S. Thus he discovered 1450 miles of the West African coast-line, and paved the way for the voyages of Diaz and da Gama. An inscription on Behaim's Globe of 1492 suggests that he accompanied Cam on his second voyage, but doubt has been cast upon this statement.

Aug. 4, 1819.—Arctic Exploration by Ship and Sledge

W. E. Parry with the ships *Hecla* and *Griper* reached Lancaster Sound, whence he proceeded westwards, discovering Barrow Strait and parts of the coasts of Bathurst and Melville Islands. The winter was spent on the latter island. In 1821, Parry, on a second voyage, discovered the Fury and Hecla Strait between Baffin Island and Melville Peninsula. On April 3, 1827, Parry set out in the *Hecla*, proposing to attempt to reach the pole by travelling over the ice in sledge boats. He reached 82° 45′ N., thus establishing a record which remained unbroken for nearly fifty years. Experience had shown that efforts to sail to the pole were fruitless; to him and to Sir John Franklin belongs the credit of the introduction of the method of polar investigation by sledge journeys.

Aug. 6, 1538.—Exploration of Colombia

Gonzalo J. de Quesada founded the city of Santa Fé de Bogotá. He reached this region, which he called New Granada, after a difficult journey through uninhabited country along the Magdalena River, which he finally abandoned for the valley of the Opon.

Aug. 6, 1584.—Early Journeys in Siberia

Yermak, the Cossack who opened the path for Russia's expansion in northern Asia, was drowned in the Irtish River. Provided with funds by the Stroganov family, merchants of Perm interested in furs, he penetrated, between 1579 and 1584, to the confluence of the Ob and the Irtish. He reached the Tura in 1580 and wintered on the site where Tiumen now stands: in 1581 he captured the native fortress of Isker or Sibir, near the present Tobolsk. The Cossacks made their journeys in sailing boats, which were dragged across portages from one stream to another. Yermak is said to have used sails to dam up a stream and thus provide sufficiently deep water for his boats. Cossack bands, after Yermak's death, continued to explore north-eastern Asia. No tributaries with easy portages connect the Lena to western rivers, and the Russians who sailed the Lena to its mouth and attempted to explore the arctic in their primitive boats suffered severe hardships, whole parties being often completely wiped out. The importance for geographical knowledge of their journeys was long overshadowed by greed for tribute, and thus the records of their routes were forgotten.

Aug. 6, 1855.—Greenland and the Canadian Arctic

Dr. Kane and his party safely reached Upernavik in small boats, having been compelled to abandon the *Advance*, in which they had set out in 1853. Kane's work included the survey of the east coast of Smith Sound, the discovery and naming of the Humboldt Glacier, the survey of 800 miles of the coast of Greenland, and the discovery and survey of part of the coast of Washington Land. His vessel, the *Advance*, reached 78° 37′ N., and sledge parties penetrated to Cape Fraser in Ellesmere Island and to Cape Constitution in Greenland. A relief expedition under Hartstene found the party at Upernavik.

Societies and Academies

London

Optical Society, June 9.—**R. A. Houstoun**: A new trichromatic colorimeter. The instrument is on a new principle, the intensity of the comparison field being altered by an iris diaphragm, and the colour by moving a magenta-yellow and a blue-magenta filter relatively to one another.—**T. Y. Baker**: The parallel plate micrometer. A plate of parallel glass placed in the convergent beam of a reading microscope is a useful means of obtaining the 'fine-reading' of a divided circle. The fine-reading scale is uniform if its length is proportional to the tangent of the angle through which the plate is tilted and if the refractive index of the glass is 1·60.—**J. Adamson**: A study of the cyclo-rotational powers of the eyes. An expression for the 'false torsion' of the eye is derived in terms of the direction of its line of fixation, and is used in calculating the extent of the compensatory cyclo-rotational powers of the eyes.—**T. Smith**: The hiding power of diffusing media. From theoretical considerations an expression is constructed as a numerical measure of the power of a sheet of a diffusing medium to hide the brightness contrasts of a surface on which it is laid. The dependence of this factor on the transmission and reflection factors of the sheet is exhibited and the effect of varying the thickness of the sheet is discussed. A comparison is made of these theoretical results with published experimental observations. The properties of all sheets may be expressed in terms of two constants, of which one is the reflection factor for an infinitely thick sheet, and the other is a factor for converting sheet thicknesses to the proper numerical scale.

Geological Society, June 22.—**Jane Longstaff** (née **Donald**): A revision of the British Carboniferous members of the family Loxonematidæ, with descriptions of new forms. Many Carboniferous species have been referred to the genus *Loxonema* (Phillips) which do not strictly belong to it. This is the case with Etheridge's Catalogue, where 25 species are given. Some of them, however, belong to the family Loxonematidæ as defined by Koken, and are referable to several of the genera into which it has since been divided. These are *Zygopleura* Koken, *Katosira* Koken, *Microptychis* Longstaff, and *Hemizyga* Girty. Three new genera are suggested for other species. The genus *Zygopleura* Koken contains by far the largest number of the species; one of these, *Z. rugifera* (Phillips), exhibits a considerable amount of variation both in size and ornamentation. The nuclear whorls, also, accord more with that genus than with *Pseudozygopleura* Knight. Twenty-six species and several varieties are described, 13 of the former being new. Six had been previously noted by de Koninck as common to Belgium, and another is now recorded: namely, *L. subconstricta* de Koninck.—**Archibald Allison**: The Dalradian succession in Islay and Jura. The author outlines results recently obtained by himself through the application of the criteria of current bedding and graded bedding, restricting his attention to the Dalradian rocks north and east of the Loch Skerrols thrust. Previously, this method of study has scarcely been used in Islay. The evidence of original order of succession is abundant, widely dispersed and consistent. Combined with the fact that the Maol an Fhithich Quartzite appears naturally to underlie the Mull of Oa Phyllites, it leads the author to conclude that the structure of Islay is an anticline, in part steeply overturned towards the north-west, in complete agreement with the views of Prof. E. B. Bailey as expounded in his paper on the Islay anticline.

DUBLIN

Royal Dublin Society, April 26.—**T. A. Bennet-Clark**: (1) A method of automatically recording the rates of oxygen intake of living tissues. The tissues are enclosed in a container forming part of a closed system through which the air is circulated by means of a special form of pump. The carbon dioxide evolved by the tissue is absorbed in baryta water in a series of Pettenkoffer tubes, as in Blackman's apparatus. The oxygen absorbed is replaced automatically by oxygen generated electrolytically whenever the fall in pressure in the apparatus, due to absorption, raises the liquid electrolyte in a differential manometer tube so as to make contact with an electrode. This enables the composition of the air surrounding the tissue to be maintained constant for a long period of time without constant attention. The rate of oxygen supply is recorded automatically, and the volume of carbon dioxide is found by titration every two hours. —(2) The respiratory quotients of succulent plants. Some measurements on *Sedum prealtum* leaves, with the apparatus described above, are in harmony with the view that the large variations which occur in the respiratory quotient (the ratio of carbon dioxide evolved to oxygen absorbed) for many hours after the leaves have been placed in darkness may be explained by variations in the quantity of malic acid present in the leaf.—**E. J. Sheehy**: Factors which determine the nutritive value (stock carrying and fattening capacity) of untreated natural pastures. Neither the chemical composition nor the digestibility of the dry matter of a pasture may be used as a criterion of its nutritive value. Fattening capacity depends upon the percentage of dry matter and on the density of the herbage, while stock carrying capacity is affected in addition by its rate of growth. These factors are correlated with the botanical composition.

PARIS

Academy of Sciences, June 13 (vol. 194, pp. 2093-2180).—**H. Deslandres**: Simple relations between the molecular spectrum and the structure of the molecule. —**Gabriel Bertrand** and **L. Silberstein**: The presence of mineral sulphides in an arable soil. A soil which reacted unfavourably towards growing plants was found to contain sulphides, decomposed by hydrochloric acid but not by acetic acid.—**d'Arsonval**: The medical applications of radioactive emanations, from the works of G. Vaugeois. A description of a method due to the late G. Vaugeois of utilising the emanation, for which certain advantages are claimed.—**Léon Guillet, Auguste Le Thomas**, and **Marcel Ballay**: The properties of copper-nickel alloys containing tin and silicon used for steam valves. The working properties of copper-nickel alloys are improved by the addition of tin and silicon. Detailed results with 37 alloys are given.—**C. Camichel** and **L. Escande**: Similitude of under-load without real linear dimensions. A discussion of Reynolds's equation of flow of incompressible viscous fluids in systems, such as submarine currents, which have no real linear dimensions.—**Maurice Janet**: The explicit determination of certain minima in problems without conditions at the limits. —**P. L. Srivastava** and **S. P. Jain**: The singularities of the Laplace-Abel integral.—**C. E. Winn**: The relation between a given series and another derived series with the same interval of oscillation.—**N. Cioranesco**: New problems on partial differential equations of the second order and of hyperbolic type.—**W. Orlicz**: Some theorems on orthogonal series.—**Mlle. M. L. Cartwright**: Some properties of the directions of Borel of integral functions of finite order.—**Pierre Ernest Mercier**: The intrinsic forms of the laws of plane motion (permanent motion).—**Émile Sevin**: Concerning the rôle of the rotation of material particles in the evolution of the universe.—**Lew Kowarski**: Very thin crystals with curved outlines. From a study of the crystals formed by the sublimation of some organic substances, especially *p*-toluidine, it is concluded that an entirely polyhedral form is not a necessary attribute of the crystalline state; it is only the final term of an evolution. Certain substances can show curved surfaces.—**D. G. Dervichian**: Surfaces and molecular volumes in superficial solutions.—**R. Lucas** and **P. Biquard**: New optical properties of liquids submitted to ultra-sound waves. Photographs of interference effects produced by passing a beam of light through water submitted to ultra-sound waves (3-15 million periods a second).—**Jean Cabannes**: Laws of polarisation of Raman lines in crystals.—**Constantin Salceanu**: The influence of temperature on the natural and magnetic rotatory dispersion of three pinenes.—**Réne Wurmser** and **Mlle. J. De Boe**: The oxido-reduction potential of the system lactic acid, pyruvic acid.—**W. S. Reich**: Contribution to the study of glycogen. By an elaborate process of purification, the author has produced glycogen containing less than 0·002 per cent phosphoric anhydride. The purified substance retains all the essential properties of glycogen; and hence it is concluded that phosphoric anhydride is not an essential constituent of glycogen.—**Hardouin, Cochet**, and **de Fleury**: Viscosities of flux and slag in the fusion of magnesium.—**Urion**: The thermal decomposition of the acyloins.—**Maurice Leriche**: The traces of an estuary formation, of Ypresian age, changed at the base of the Lutetian at the western edge of the Paris basin.—**H. Vincienne**: The horizontal disengagements in the south of the Jura: the tectonic and morphological rôle.—**Edouard Roch**: Geological observations in the region of Entifa and Beni Ayatt, to the north-east of Marrakesh (Morocco).—**V. Frolow**: The dissolved salts in the underground waters of the Palmyre region. The variations in the dissolved salts in three springs in this region with the time of year have been determined, and the results given graphically.—**A.** and **R. Sartory, J. Meyer**, and **M. Antonioli**: Cytological researches on the development of *Actinomyces Allenbachii*.—**Paul Becquerel**: The revivification of dried seedlings after placing in a vacuum and at very low temperatures. Seedlings of wheat, rye, lucerne, and annual sunflower, after prolonged drying in a vacuum, with subsequent exposure for 18 days at − 190° C. (liquid nitrogen), and to a further treatment at − 269° for 9 hours and − 271° for one hour (liquid helium), with two exceptions, developed normally. —**R. Echevin**: The autumnal migration of phosphorus in the leaves of trees. During the change in colour from green to yellow, the protein phosphorus diminishes.—**Mme. H. Heldt**: Fertilisation in *Parapenæus longirostris*.—**Paul Wintrebert**: The primitive streak of amphibians; a new phase of the development shown by the coloured markings.—**Marcel Avel**: An experiment permitting the regeneration of the head in the proved absence of the ventral nerve chain in *Lumbricus*.—**E. Biancani, H. Biancani**, and **A. Dognon**: The action of ultra-sound waves on isolated cells in suspension.—**Georges Deflandre**: The genus *Podamphora* and its relations with the Ebriaceæ.—**F. Labrousse**: The fluorescigen function in the phytopathogenic bacteria. In two bacteria studied, the fluorescence depended on the amount of magnesium phosphate in the culture fluid.—**A. W. Sellards** and **J. Laignet**: The control, by a test on *Macacus rhesus*, of the protective power of the serum of men vaccinated against yellow fever with mouse virus. The tests prove the high degree of immunity conferred by this method of vaccination.—**E. Roubaud** and **J. Colas-Belcour**: The adaptation to submerged life during the winter in the larvæ of *Anopheles plumbeus*.

CRACOW

Polish Academy of Science and Letters, March 17.—**A. Skapski**: *Endosmosis through a semipermeable spherical membrane.*—**Mlle. A. Dorabialska**: Researches on the anomalous thermal effects given by some radioactive minerals. It has been proved that these anomalous effects cannot have been caused by secondary physical actions, such as adsorption of vapours or gases. From the study of two minerals, orangite and monazite, the thermal effect has been found to reside in the fractions containing the elements of the lanthanum and yttrium group. Cerium and erbium do not give out thermal energy.—**M. Centnerszwer** and **S. Lewi**: The influence of the temperature on the velocity of solution of thallium in nitric acid. The temperature coefficient $K_{35°}/K_{25°} = 2{\cdot}06$; agreeing with the data of van 't Hoff for the effect of temperature on chemical reactions.—**M. Centnerszwer, Mlle. C. Weker,** and **Mlle. S. Majewska**: The velocity of evaporation of liquids in a current of air. Experiments on the velocity of evaporation of water, benzene, and toluene and its variation as a function of the velocity of the current of air.—**K. Dziewoński** and **J. Moszew**: *A new method of synthesis of compounds derived from quinoline.*—**Mlle. M. Turnau**: Some remarks on the geometric analysis of rocks.—**H. Teisseyre**: The morphological problems of the eastern Polish Sub-Carpathians.—**W. Friedberg**: The Miocene Pectinideæ of Poland and their stratigraphical value (1).—**F. Rogoziński** and **Mlle. J. Ciechanowska**: Experimental rickets (4). Wheat as a food causing rickets. The rickets produced in white rats and chicks by an exclusive wheat diet can be prevented by adding calcium salts in sufficient quantity to ensure a proper ratio of calcium to phosphorus.

ROME

Royal National Academy of the Lincei, Feb. 7.—**U. Cisotti**: Motion with 'wake' of a flexible profile (1).—**L. Lombardi**: An absolute voltmeter for the measurement of large differences of potential. On May 1, 1931, Prof. W. M. Thornton described an absolute voltmeter composed of a metallic ellipsoid of revolution, suspended between two plane parallel armatures, with its major axis inclined at 45° to the direction of the field. This device was applied and exhaustively discussed by the author in his doctorate thesis at Zurich in 1895.—**G. Giorgi**: New ideas on the theory of relativity. The theory of relativity has passed through three stages, the first termed restricted relativity, the second improperly named generalised relativity, and the third including the scheme of Einstein for a unitary description of gravitational and electromagnetic fields and those of other authors having the same purpose. Suggestions are now put forward which may lead to a further advance.—**E. Paternò**: (1) Cellulose xanthate and viscose.—(2) Soluble or peptonised cellulose. The form in which cellulose exists in its colloidal solutions is discussed.—(3) Composition of artificial silk. The experimental results described indicate that viscose silk is not hydrocellulose, but a mixture of a form of cellulose not yet defined with a substance which may be dissolved from the silk by soda solution.—**T. Boggio**: Certain vectorial formulæ in curved, three-dimensional spaces. The way in which some of the more common formulæ of ordinary space are modified in curved spaces is considered.—**G. Sansone**: Zeros of the polynomial solutions of the equation $(a_1x + a_0)y'' + (b_1x + b_0)y' - nb_1y = 0$ (ii).—**C. Miranda**: The summation of Hermite's series by Poisson's method.—**L. Campedelli**: Double planes with curve of branching of the eighth order.—**N. Sakellariou**: The calculus of variations.—**Giacinta Andruetto**: Saint-Venant's formulæ for curved spaces of three dimensions.—**G. Krall**: Asymptotic effects of the tides on the motion of the celestial bodies. (1) Generalities and problem of two bodies.—**R. Serini**: The Doppler phenomenon for vibrating cords.—**V. Zagami** and **V. Famiani**: Comparison between the food value of certain vegetables and that of certain cereals. Experiments with young albino rats show that increase in weight and development of the genital organs are retarded by exclusive feeding of the animals on peas or lentils, and that still greater effects are produced if cereals form the only food. Less pronounced calcification of the skeleton and other bodily defects are also observed.—**Giulio Cotronei**: Zoological constitution and grafting (9).—**M. Curzi**: Contribution to the knowledge of the biology and systematics of strains of *Sclerotium* Rolfsii.

Forthcoming Events

Congress

AUG. 1–6

FIRST INTERNATIONAL CONGRESS OF PREHISTORIC AND PROTOHISTORIC SCIENCES, London. (See NATURE for July 16, p. 104.)

Official Publications Received

BRITISH

The Journal of Armstrong College Mining Society, July. Pp. xxi+91. (Newcastle-on-Tyne.) 1*s*.

Canada: *Department of Mines; Mines Branch.* The Clay and Shale Resources of Turner Valley and nearby Districts. By W. G. Worcester. (No. 729.) Pp. v+126. (Ottawa: *F. A. Acland.*) 20 cents.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1444 (T. 3156, 3170, 3192): Torsion and Flexure of Cylinders and Tubes. By Dr. W. J. Duncan. Pp. 78. 3*s*. 6*d*. net. No. 1445 (T. 3127): Interference between Bodies and Airscrews. By C. N. H. Lock and H. Bateman. Pp. 38+5 plates. 1*s*. 9*d*. net. No. 1458 (T. 2980c): Measurement of Take-Off and Landing Runs. By D. Rolinson. Pp. 8+2 plates. 4*d*. net. (London: H.M. Stationery Office.)

Memoirs of the Geological Survey of India: Palaeontologia Indica. New Series, Vol. 18: The Fossil Carnivora of India. By Dr. Guy E. Pilgrim. Pp. vi+282+10 plates. (Calcutta: Government of India *Central Publication Branch.*) 13.12 rupees: 22*s*. 3*d*.

Indian Institute of Science, Bangalore. Investigations on the Spike-Disease of Sandal. 5: Report of Progress made during the Quarter ending 31st March 1932. Edited by Dr. V. Subrahmanyan. Pp. ii+18. (Bangalore.)

FOREIGN

The Bashford Dean Memorial Volume. Archaic Fishes. Edited by Eugene Willis Gudger. Article 4: The Structure of *Dinichthys*; *a Contribution to our Knowledge of the Arthrodira.* By Anatol Heintz. Pp. iv+115-224+9 plates. (New York: American Museum of Natural *History.*)

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Vol. 41, Fasc. 2: Études sur la Partie Occidentale du Lac de Genève; Courants et Températures. Par A. Bétant et G. Perrenoud. Pp. 225-293+12 planches. (Genève: Georg et Cie.) 20 francs.

Proceedings of the Imperial Academy. Vol. 8, No. 5, May. Pp. ix-xv+143-216. (Tokyo.)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 10, Part 2, May. Pp. 273-498+plates 39-58. (Tokyo: *Iwanami Shoten.*) 3.40 yen.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 84. *Birds collected in Northeastern Nicaragua in 1922.* By Wharton Huber. Pp. 205-249. Notes on Montana Orthoptera. By Morgan Hebard. Pp. 251-257. Notes on the A. Blaney Percival Collection of East African Birds, Part 1. By W. Wedgwood Bowen. Pp. 259-280. Angolan Birds collected during the Second Gray African Expedition, 1930. By W. Wedgwood Bowen. Pp. 281-289. (Philadelphia.)

Contributions to the Genetics of the Domestic Rabbit. By W. E. Castle and Paul B. Sawin. (Publication No. 427.) Pp. iv+50+12 plates. (Washington, D.C.: Carnegie Institution.)

Journal of the Faculty of Science, Hokkaido Imperial University. Series 2, Physics, Vol. 1, No. 3, April. Pp. 87-119. (Sapporo.)

Annual Report of the Meteorological Observatory of the Government-General of Tyosen for the Year 1930. Pp. 170. (Zinsen.)

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 13, 1931. *ii.* Nederbörden i Sverige. Pp. 159. (Stockholm.) 5 kr.

CATALOGUES

SATURDAY, AUGUST 6, 1932

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Industrial and Business Administration

BEHIND the growing attention which is focused in these days on planning as an integral element in industrial revival or in national and international recovery, there is an increasing consciousness that the demands which are habitually made on leadership, whether of industry or of the State, are far more onerous than those of a few decades ago. It is not sufficient now for an industrial administrator to be competent to assess merely the internal and local factors of his industry. Whether they are financial, economic, political, or technical, he is compelled to extend his view to the national industry as a whole, and beyond that to an increasing extent to the industry as a world unit. Indifference to the international aspects of industry, like neglect of the technical and scientific factors, invites disaster, and this is as true of national administration as it is of industry. It would be difficult to name a single first-class problem with which modern political administrators are confronted which does not involve in its solution intricate and essential technical and scientific factors which cannot be appraised apart from scientific and technical knowledge.

As we have repeatedly urged in these columns, both industry and the State have in Great Britain suffered too much in the past from administrators whose deficiencies in scientific outlook and knowledge rendered them incapable of maintaining an adequate scientific staff, or of accepting an adequate and sustained programme of research as a fixed charge, comparable with insurance, depreciation, or obsolescence, and incorporating its results in industrial practice. In industry, however, this tendency is passing. The successful development of the newer industries such as those concerned with electrical equipment, automobiles and aviation, or the manufacture of synthetic products such as rayon, resins, etc., which has been primarily dependent upon research and the application of the results of scientific and technical investigation in commercial practice, has involved the organisation of close co-operation between administrators and controllers of policy and those responsible for research and other technical matters. The increasing authority and prestige of the technical expert in such industries is now extending to older industries, as may be seen in the appointment of an eminent man of science to direct and co-ordinate all research for the London Midland and Scottish Railway, an appointment carrying a status corresponding to that of the principal directing heads on the administrative side.

As a result of these developments in industry, there has thus been a considerable change from the control of industry by those whose chief qualifications are financial and commercial to control by boards of directors which collectively combine the knowledge of finance, general organisation, administrative problems, and the trend of scientific and technical developments requisite for wise and far-seeing decisions on general policy. To this process the merging of industrial undertakings for the purposes of technical rationalisation has given a further impetus. Much of the wider and more urgent interest in management problems is derived from the rationalisation of industry. In fact, it may be said that the brief history of rationalisation in the world has already convincingly demonstrated that the success of a rationalisation policy is bound up inseparably with leadership competent to evaluate accurately all the relevant factors involved, whether scientific, technical, financial, or commercial. It is probably deficiencies in one or other of these respects, and consequent failure, that has led to suggestions that efficient administration of some of the largest international mergers is a task beyond human powers. Authoritative inquiry has, however, failed to reveal any evidence of such inherent limitations on human ability, and public opinion is gradually becoming sufficiently enlightened to perceive the true cause of such failures as lying in those who insist on discussing questions and policies involving technical or scientific considerations without the assistance of the appropriate experts.

Evidence of this change in the attitude of industry, and indeed of public opinion, can be found in the progress of such diverse institutions as the International Management Institute with its associated Management Research Groups, the Institute of Industrial Administration, which aims at establishing industrial administration as a recognised profession, as well as in the inclusion of a discussion on scientific management problems in the programme of Section F (Economics) at the centenary meeting of the British Association last year.

Among these, one of the most interesting experiments is the Department of Business Administration at the London School of Economics and Political Science.* Established in 1930 through the joint efforts of leading business firms and school authorities, and financed mainly by business subscribers, the Department of Business Administration provides selected students with full-time training in the broad principles of business administration, as well as, where necessary, giving a preliminary general economic training. The Department does not aim at large numbers of students but at giving personal attention to a limited number each of whom has given evidence of an adequate general education and of personal qualities likely to make them suitable for a business career. The primary object of the training is to develop the quality of judgment and the breadth of view required for solving the practical problems which are encountered in business life. A secondary object is to provide a background against which the students can place the problems they afterwards meet.

With these objects in mind, instruction is carried on mainly by means of small discussion classes, including what is known as the problem or case method, supplemented by written work. Material supplied by business firms and illustrating the actual problems of business life is used in class discussions. In addition, the systematic investigation of business problems, organisation, and methods, mainly from the point of view of the individual concern, forms an integral part of the Department's work, and in time the Department hopes to cover a number of the major fields of business activity, although its present plans are limited to the study of certain aspects of marketing and business finance. In the latter field an investigation has been undertaken on the financial structure of business with the object of ascertaining whether normal forms of capitalisation exist for different types of business.

The Department of Business Administration is thus a definite attempt to meet the need for business training which is at present so ill provided for. Obvious criticisms can be made of its aims and methods, but it is not suggested that the course can do more than assist the formation and development of habits of judgment which will mature in actual experience of business and industrial life. The training provided by the Department has new advantages in the extent to which it renders available for the coming generation of administrators the experience of many firms of varying sizes and in different branches of industry or commerce. The breadth of experience thus offered is far greater than could be acquired in any one firm, apart from the practical difficulty which would be encountered in a firm of any size in the student acquiring experience by working his way through the different departments of the firm.

The scheme of training thus briefly outlined is an

* The London School of Economics and Political Science (University of London), Houghton Street, Aldwych, W.C.2. Department of Business Administration, Session 1932–33. Pp. 28. Training for Business Management. Pp. 11. (London, 1932.)

experiment which is still developing and has not reached its final form. It can be justly claimed for this novel attempt to meet the need for fresh methods of recruiting and training business administrators for the future which arises from the changed economic conditions of the world, that it is based on a closer co-operation of academic and business authorities than has hitherto been achieved in Great Britain, and without abandoning any academic standard it seeks to base training for business upon business. It should not be too much to hope or expect that training along such lines will assist in the development not of scientific management as a restricted profession, however efficient, but in the provision for industry and the State alike of administrators versed in tried principles of administration and competent to assess the technical and scientific factors entering into problems they are called upon to solve. A generation of such administrators in government service and in industry would speedily ensure that the scientific expert took his rightful place in the business or mechanism of government in industry or in the State.

Inevitably, administrators of the required standard will only be forthcoming if the recruits for such courses are drawn as freely from scientific workers as from those who have graduated in arts or law or economics, and if the government service is at present lamentably behind industry in the scope it affords for administration by those having first-hand knowledge of science, the present tendency towards functional representation will ultimately make it easier for industry to influence State administration in the same direction. The firm establishment of the expert and the expert committee in industrial administration, and the proof of the scientific worker's competence to meet the searching demands of administration in an industrial merger on an international scale, should finally result in the scientific expert taking a corresponding part in the machinery of national and international government. Already the value of the expert committee has been demonstrated in the international sphere, and it behoves the scientific worker to watch with great interest all such experiments as that of the Department of Business Administration which seek to raise the standard of industrial administration or to promote scientific management, and to lose no opportunity of qualifying himself to discharge more efficiently those administrative functions from which in the present age he cannot escape, if industry and society alike are to avoid disintegration.

Matter and Conceptions

The New Conceptions of Matter. By Prof. C. G. Darwin. Pp. viii + 192 + 6 plates. (London: G. Bell and Sons, Ltd., 1931.) 10*s.* 6*d.* net.

IN this book the author aspires to a popular account of the recent developments of atomic physics—in particular, that aspect of it which is known as 'wave-mechanics'.

"I believe [he writes of his presentation] that it makes a consistent formulation of the foundations, which only needs the help of mathematics to yield all the results of the theory so far obtained. However that may be, I have little hesitation in saying that, if it is to be at all possible to present the new mechanics in popular or even semi-popular terms, it must be done more or less on the lines I have adopted here."

Speaking broadly, the method referred to may be described as that of giving a familiar physical interpretation to the mathematics of the subject. Since the mathematics does not on the whole lend itself to very obvious interpretation, this leaves considerable scope for the ingenuity of the expositor, and Prof. Darwin's chief difficulty has been to interpret the equations in the most 'natural' way.

"I shall count myself as having succeeded [he writes], if at the end of the book any surviving reader will speak no longer of the mysteries of science, but, shall we say, of the naturalness of Nature."

It may be said at once that, if we admit the legitimacy of the aim, the task could scarcely have been performed more satisfactorily, and many a student of advanced physics will call Prof. Darwin blessed. Every such student should read the book, for it provides him with what he will not obtain elsewhere with the same completeness and general excellence; namely, an approach to the incomprehensible mathematics of the subject by way of the physical counterparts of equations in more familiar branches of physics.

The account of the diffraction of electrons, the real starting-point of the book, is prefaced by some seventy pages of introductory matter dealing with fundamental physical conceptions, wave motion, and the principle of least action. As an interpretation of the new experimental facts we are introduced at once to the uncertainty principle and the duality of wave and particle, and in the light of these basic conceptions the structure and behaviour of the atom, polarisation of waves and particles, collisions between particles, and the exclusion principle are successively discussed. The

treatment is well conceived, clear, and very interesting, and it is difficult to see how in its general features it could be improved.

If, however, we consider the book not 'as in itself it really is' but in relation to its object, we can only describe it as a magnificent failure. Success, indeed, seems to us impossible, for it presupposes a reading of the lessons of modern physics which we cannot accept. To Prof. Darwin, mathematics (or, as we prefer to say for the sake of generality, logic) is the scaffolding by which physical models are erected, and his task is to remove it and reveal the structure.

> "The new discoveries which I am to describe were only begun five years ago, and so it is hardly surprising that they are still partly covered with the scaffolding of mathematical formalism. But I hope to show that the time has already come, when it is possible to free the structure from a good deal of this scaffolding and so to gain something of an intuitive view of what the world is really like."

What are the facts? Simply that until lately there has always been a one-to-one correspondence between the concepts of atomic physics and objects of experience, but that the latest concepts have no empirical correlatives. Prof. Darwin's view is that such correlatives exist and we have to find them; if he is right, then his aim is capable of fulfilment. But it is a possible interpretation that the whilom correspondence was a merely superficial characteristic, and that its breakdown is not a temporary inconvenience but an indication that in our investigations of the relations between phenomena we have got below the surface. If that is the truth, then Prof. Darwin sits in the chair of Cnut.

It is, of course, a matter of opinion at present, and Prof. Darwin's opinion is entitled to as much weight as another's. We cannot, however, think that his book will lend it much support. If anyone, on reaching the end, speaks of the 'naturalness of Nature', it will be in the hushed tones due to departed majesty. More than once Prof. Darwin finds it necessary to apologise for the imperfection of his descriptions of ideas "which are mathematically fairly easy", whereas, we think, he should have apologised for their success, because in so far as they succeed they are of necessity misleading. A great part of the book is, of course, concerned with the view of the electron as a wave, but if the reader asks, 'A wave in what?', he will find no answer unless he wrongly, but perhaps excusably, interprets pp 22-23 as replying, "Waves in the luminiferous ether". He may succeed in realising that the wave and particle aspects of the fundamental concepts are not contradictory but complementary, but he will not discover why they should both exist or how they can be unified. The only answer provided to the old query why one aspect is presented on Monday, Wednesday, and Friday, and the other on Tuesday, Thursday, and Saturday, is that one day does not overlap another. This falls somewhat short of "an intuitive view of what the world is really like".

It is questionable whether even some of those who admit the unpicturability of modern physical concepts have realised the revolution which it causes in the principles of popular exposition. We speak of 'wave mechanics', and thereby introduce a completely false idea. When an elastic solid ether was the orthodox belief, it was permissible to speak of waves in the ether just as one spoke of waves in water. The two waves were not merely interpretations of the same equations; they were physically identical interpretations. But an electron and a water wave are not physically identical, and it is as misleading to call an electron a wave as to call a water wave an electron. Our language has suddenly become figurative, and it is not realised that in using it for the uninitiated the impression made is as if, for example, we claimed that the unliberated content of Pandora's box was Watts's well-known picture because both are represented by the symbol 'hope'. Men of science have turned poets, and the public takes their metaphors literally.

If, however, we are prepared to swallow this camel, Prof. Darwin provides us with very few gnats to strain at in the way of incidental analogies. This is one of the most pleasing features of his book, and it is therefore extremely unfortunate that one of the few analogies which are introduced should be a particularly bad one and should deal with a particularly important point. The wave and particle aspects of the electron are likened respectively to the objective and subjective aspects of a sound or colour because of their absolute separation but interdependence. The question of analogy in popular description is so vital and so consistently neglected that it might not be out of place to give it a brief general consideration here.

It is easy to prove that an analogy is at best worthless and at worst misleading. The analogue, not being identical with the point to be illustrated, has certain relevant and certain irrelevant elements. If the reader does not already understand the point in question he has no means of distinguishing between them, and if he does understand it the analogue is superfluous.

Actually the human mind gets round this logical obstacle by virtue of the fact that certain previous experiences spontaneously spring to mind when the analogue is mentioned, and these are accepted as the relevant elements. It follows that a successful analogue will be one of which the relevant elements really are those which will thus spontaneously occur to the reader. Thus, the solar system was, on the whole, a successful likeness to the Rutherford atom; it led no one to think of electrons as abodes of life, though, it is true, a student might have conceived of them as rotating bodies before there was justification for that idea. The outstanding fact of the solar system, however, is the revolution of satellites round a central mass, and the analogue was a good one because that was the relevant element of it.

Prof. Darwin's analogy, on the other hand, is a bad one, because the contrast between 'subjective' and 'objective' will be immediately interpreted, by most readers at least, as a contrast between something existing in the 'mind' and something existing in the 'external world'. Just as a deaf person will have no subjective experience of the 'middle C', but may yet know all about its objective aspect through mechanical experiments, so —the reader will imagine—he himself might, by physical injury, lose the power of detecting the particle aspect of an electron, but retain intact his appreciation of the wave aspect. He will then wonder why the particle aspect is introduced into the scientific description at all, and if he has chanced to hear elsewhere that Heisenberg and Bohr, with reference to a different point, have claimed to show that subject and object are inextricably interwoven in physical theory, he will be fairly caught in a net of confusion into which Prof. Darwin's habitual clearness of expression, so far from delivering him, will only draw him the tighter because of his unwillingness to believe it to have failed. It is much to be hoped that in future editions this objectionable illustration will be removed.

Prof. Darwin more than once, and rightly, insists on the principle that 'unobservables' must be expelled from physical discussion. This is undoubtedly the great contribution of modern physics to thought in general. It is of the first importance, therefore, that it should be stated precisely, and this unfortunately is not done. We refer not so much to the statement (p. 81) that "if a thing is essentially unobservable then it is not a real thing", which might lead to misunderstanding among those whose definition of reality is not that of the physicist, as to the discussion on p. 156 which culminates in the remark:

"It is meaningless ever to ask what has happened, unless there is either a direct or an indirect observation to tell one; and if there is an observation it is pointless to ask, because one knows the answer."

The necessary conclusion is that in no circumstances is it anything but futile to ask what has happened. The true point of the principle is that events which cannot *conceivably* be observed, owing to their relation to the processes of observation, are taboo, and that is a very different thing. It allows us, for example, to discuss the far side of the moon, which on Prof. Darwin's principle is illusory.

The book is well produced, and contains several original diagrams. Herbert Dingle.

Fashions in Deformity

Artificial Cranial Deformation: a Contribution to the Study of Ethnic Mutilations. By Dr. E. J. Dingwall. Pp. xvi + 313 + 54 plates. (London: John Bale, Sons and Danielsson, Ltd., 1931.) 70*s*. net.

ONE of the strangest eccentricities in human behaviour is revealed in the widespread practice among even civilised men and women of bodily mutilations, such as scarring and tattooing, piercing ears, noses, lips, or tongue, circumcising, knocking out teeth, compressing the feet, amputating fingers, compressing the waist, and distorting the head. These procedures are so devoid of rational justification and so destructive of the natural beauty of the human form that it is difficult to discover any plausible excuse for their invention. Hence the geographical distribution of such deformities affords valuable evidence in support of claims for the diffusion of culture in early times.

Obviously it is a matter of importance to submit the evidence relating to each of them to the most critical and exhaustive study to discover whether in fact they do throw any decisive light on theories of diffusion or independent development. Dr. Dingwall has performed the onerous task of collecting and setting forth the facts relating to the practice of deliberately deforming the heads of children so as to confer upon them more or less the fantastic and unnatural shapes which fashion dictates for the aristocracy of certain peoples. He has refrained from drawing conclusions: he has attempted to cite the evidence with complete impartiality, without neglecting, however, the important matter of recording the associated customs and beliefs. Although he cites nearly 1200 memoirs

and treatises, he modestly disclaims regarding this list as an adequate bibliography.

Writing in 1915 of the diffusion of culture, I directed attention to the fact that the practice of cranial deformation was intimately associated with the megalithic complex, and tentatively suggested that the distortion of the head may have been first invented in Asia Minor and secondarily associated with the custom of building rude stone monuments in the course of its diffusion. The observations of Dr. L. H. Dudley Buxton, the results of which were given verbally to Dr. Dingwall (and since published, in part, in the *Anthropologischer Anzeiger,* 7, p. 236; 1931), establish the fact that the earliest actual examples of artificially distorted skulls so far recovered come from Crete and Cyprus. They belong to the period of "the late Minoan III., when Bronze Age Cretans had a lively trade with Egypt". From this period in Egypt there have been recovered several busts of Akhenaten's daughters (1360 B.C.) displaying extreme forms of the same intentional cranial deformation; and in the pictures of the Heretic King himself and of his Queen a less extreme form of the same peculiarity is suggested. In spite of the doubts which have been expressed, it is beyond question that Akhenaten's portraits reveal pathological changes, which afford a measure of justification for his artists' fantastic exaggeration of his peculiarities. Whether or not this fashion in mutilation began from an imitation and exaggeration of Akhenaten's natural affliction it will be impossible to decide until authentic skulls of the period have been found. Yet there is positive evidence that about the same time artificial deformation was being practised in Crete and Cyprus.

Dr. Dingwall gives fully documented evidence of its practice in past and present times in Europe, Africa, Asia, the Malay Archipelago, Melanesia, Polynesia, and especially in North and South America, including descriptions of the technical methods employed to effect the mutilation. "We may well ask", he remarks (p. 237), "with Quatrefages whether it is coincidental that the deformed skulls of the Caucasus, France, and America are so similar." "Writing in 1889 he (Quatrefages) says that it is indeed difficult to admit that the idea of deforming the human head in such an extraordinary way has been independently evolved in each of those peoples where we see its manifestations." Quatrefages adds: "one is forced to admit evidence both of diffusion and the contact of cultures". Dr. Dingwall thinks that this opinion "is not to be passed over lightly. The custom of cranial deformation is not uniform in all parts of the world. It cannot be the response to some innate human impulse. Confining the custom almost exclusively to a certain class suggests that the idea is either derived from, or connected with, some notion concerning differences between aristocracy and commoners."

In the laborious task of collecting and setting out the enormous mass of data concerning one of the strangest eccentricities of human fantasy, Dr. Dingwall has rendered a conspicuous service to all students of human history. The book is well illustrated with photographs, drawings, and maps. It should be included in every library concerned with anthropology or the vagaries of human inventiveness. G. Elliot Smith.

British Beetles

A Practical Handbook of British Beetles. By Norman H. Joy. In 2 volumes. Vol. 1. Pp. xxvii + 622. Vol. 2. Pp. 194 (170 plates). (London: H. F. and G. Witherby, 1932.) 63*s.* net.

A DESIDERATUM of long standing was a reasonably priced manual on British Coleoptera. The standard work by Fowler, and especially its illustrated edition, is beyond the means of most students and collectors of insects. In supplying this want, Dr. Joy has set himself the difficult task of dealing in a limited compass with a fauna of about 3560 different species. He approaches his subject with a background of wide experience as a coleopterist, and with a keen appreciation of the difficulties, which especially beginners encounter, in the identification of so many of the species of the order. He has, therefore, written what is essentially a manual of identification for the use of collectors.

The subject matter is arranged in the form of dichotomic keys: first, keys to the superfamilies (or suborders, as the author terms them), then keys to the families of each, and so on down to the genera and species. His principle is to select diagnostic or critical characters, so far as possible, in each series of keys, and so avoid detailed technical descriptions. Ample cross-references to text and plates are given, and much space is saved by the use of abbreviations for frequently recurring terms and for indicating distribution. The essential letterpress fills vol. 1, while vol. 2 consists of 169 plates portraying species and structural details in more than two thousand separate figures. These latter are, for the most part, original, and are reproduced as clear line illustrations. With the aid of these two volumes, the process of identifica-

tion has been reduced to the limits of simplicity, without, it is to be hoped, undue sacrifice in other directions.

In the taxonomic arrangement of the book, convenience takes precedence over orthodox scientific sequence. Thus, the work begins with the Brachelytra and ends with the Clavicornia. The nomenclature followed is mainly that of Heyden, Reitter, and Weise (1906). Here possibly difference of opinion may arise as to how far this system is sufficiently modern for certain of the groups.

Viewed as a whole, it may be said that the author has carried out his task extremely well. His unconventional treatment may annoy purely scientific users, but it has definite advantages. We think that the beginner, more especially, will prefer Dr. Joy's volumes to any others, and for that reason they will impart fresh stimulus to the study of British Coleoptera. The two volumes are excellently produced: the paper and binding are good and the type large and clear; misprints are few. Mention must also be made of the very efficient indexes. The book deserves every success, and if regular usage proves it to be accurate and reliable we think that its success will be assured.

A. D. IMMS.

A Plain Man and a Mystic

(1) *Rural Rides.* By William Cobbett. Pp. xiv + 363. (2) *A Week on the Concord and Merrimac Rivers.* By Henry Thoreau. Pp. viii + 361. (Open-Air Library.) (London and Toronto: J. M. Dent and Sons, Ltd., 1932.) 3*s.* 6*d.* net each.

A FOREWORD by Mr. Fitch Daglish introduces us, in friendly fashion, to Cobbett and to those "Rural Rides" of which he wrote in his *Weekly Register*, a hundred years ago. He was sorely troubled by the "distressed state of the agricultural interest", all due (or so he says) to the "desolating and damnable system of paper money"; and this and what more he has to say on taxes and national debt sounds familiar to us, now that we are down again after a hundred years in the trough of an economic wave: "The system", he says, "seems to have fairly wound itself up; to have tied itself hand and foot with cords of its own spinning".

Cobbett was a good knowledgeable farmer, and his remarks on the farms by which he kept riding are vigorous and original. He always knew the soil below by the crops above, and badly farmed land or ill-kept cattle roused his contemptuous indignation. Courageous and prejudiced, he had that most useful political weapon, a knack of finding the appropriate and opprobrious epithet; and he seemed to have a personal interest in every cultivable inch of English soil. He was more than sixty years old when he rode those rural rides of his in all weathers, on a horse after his own heart, "tall, strong, gentle, and bold". He rode through villages and towns (or "wens", as he is fond of calling them) from Hants to Northumberland, welcomed everywhere by those "good and sensible men" who took in the *Weekly Register* and rang the church bells when he arrived. His many digressions are pointed and lively. He hates the agricultural monopolist, "the great bull-frog who takes all", neither more nor less than the city "tax-eaters and such vermin"; he loathes the teaching of the "barbarous and impious Malthus"; he has a pithy phrase always ready to hand, such as "a poor spewy gravel"; he admires the public spirit and political instincts of the race of cobblers; and on beholding the Oxford Colleges, he can't help thinking of "the drones they nourish and the wasps they send forth".

Cobbett's reaction to Nature was that of the eighteenth century, that of a disciple of Swift and of Voltaire. He thinks little of birds or of flowers; his interest lies with trees, and with those which are most useful to mankind. The unkempt but lovely larch "is fit only for burning". He was not insensible to beauty, but his appreciation of the country landscape was direct and agricultural. His spirit found freedom and well-being in the open air; and the familiar sights of farm and field, dear to him from childhood, stimulated his lively and curious intelligence to express itself in clear, easy, and trenchant prose.

Thoreau's "Week on the Concord" is another famous book of the open road, but its spirit is altogether different from that of the "Rural Rides"; it reflects the clean-cut and remarkable change of mood which is known as the romantic revival of the mid-nineteenth century. The two authors wrote under different inspirations, and besides, they were two very different men. Cobbett was a natural, warm-hearted, lovable, and exasperating man, with the reformer's aggressive sense of injustice, and with the usual accompanying touch of human vanity. Thoreau was a prig, self-conscious and philosophical; but his love of Nature and of books was genuine enough, if a trifle undiscriminating. He was a better naturalist than Cobbett and could write very pleasantly; but he was guilty now and then of execrable phrases and offensive sentimentality. Between the two men we become aware of

one of those complete changes of temper and of outlook which happen now and then in history. Human mentality itself seems to break down in a sort of emotional 'histolysis'; and the new generation can scarcely speak or understand the language of the generation before.

If we love quaint pieces of local history, scraps of folklore, and rambling disquisitions on philosophy, we may find them all in Thoreau. The angler will love his intimate pictures of "our finny contemporaries"; his leisurely descriptions of banks and woodlands will charm many a reader. The older naturalists of the countryside, lovers of the hedgerow and the open road like Cobbett and Thoreau, have been out of fashion for a while; and these pleasant books introduce us to them again.

L. STARKE.

Short Reviews

Men of the Trees: in the Mahogany Forests of Kenya and Nigeria. By Richard St. Barbe Baker. Pp. 283 + 31 plates. (London: George Allen and Unwin, Ltd., 1932.) 12*s.* 6*d.* net.

CAPT. BAKER is a forestry officer, not an anthropologist; yet his story of how he enlisted the services of the natives in conservation and afforestation work is an object-lesson in the practical application of knowledge of native custom and psychology to a problem in which the practice of the indigenous inhabitant ran counter to the end which the administration had in view. Probably Capt. Baker's object could not have been attained in any other way. An order framed to constrain native action might have been ignored or even disobeyed; and, in any event, it would almost certainly have led to friction.

From time immemorial, native methods of agriculture have been destructive of the forest. Small clearings are made, by fire and the machete, which are cultivated for a short time and then abandoned. The group—family or tribe—then moves on to another patch, and the process is repeated, the trees which have been destroyed not being replaced by planting. Capt. Baker secured the co-operation of the natives in his work of repairing the damage, and averting it in the future, by an appeal to their love of festivals and ceremonial dancing and their desire for social distinction through membership of a secret society or esoteric group. He formed a band of 'Men of the Trees', to which only the elect were admitted, pledged to plant and protect trees everywhere, distinguished by insignia, and owning its own special dance. Of its success we may leave the author himself to tell; but lest it may be thought that his story weighs as much against as for an anthropological training, as he was not an anthropologist, we hasten to add that his sympathetic understanding of the native is of an exceptional calibre.

This is indeed no scientific treatise on the forest trees of Kenya; but it may serve to spread among the general public a knowledge of the potential wealth of the timbers of the country if administered with care and skill.

The Taylor Series: an Introduction to the Theory of Functions of a Complex Variable. By P. Dienes. Pp. xii + 552. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 30*s.* net.

A POWER series of the form $\Sigma a_n(z-z_0)^n$ which converges at more than one point, converges inside a circle centre z_0 and coincides with the series obtained by applying Taylor's theorem to the sum-function. If another point z_1 is taken inside the circle of convergence, the function can be developed in a series $\Sigma b_n(z-z_1)^n$, which also converges inside a circle centre z_1, the area of which may extend beyond that of the original circle of convergence. An analytic function is defined by the original series and all possible transformed series obtained in this way. Since the coefficients b_n are obtained uniquely from the coefficients a_n it follows that the whole behaviour of the function must be determinate when the sequence of coefficients a_n is known. The problem of Taylor's series is therefore to deduce from a knowledge of the coefficients the behaviour of the function.

The first seven chapters of this book give the elementary properties of functions of a complex variable, ending with Jordan's theorem and a rigorous proof of Cauchy's theorem. These chapters are furnished with a variety of exercises. Chap. viii. discusses biuniform mapping and the theorems of Bloch, Schottky, Landau, and Picard. Chap. xi. deals with various means of representing a one-valued analytic function by an explicit formula. The problem of uniformisation is not discussed, as being beyond the scope of an introductory treatise. Chap. x. considers singularities and Chap. xi. overconvergence and gap theorems. Chap. xii. on divergent series gives a welcome and systematic discussion of generalised limits and sums. In Chap. xiii. this theory is applied to the Taylor series on its circle of convergence. Chap. xiv. discusses the relations between singularities and divergence.

The whole book forms a very useful introduction to the theory of functions of a complex variable, and the author is to be congratulated on the manner in which he has systematised such an immense amount of material in a way which is calculated to give a proper perspective of the subject. The printing is good, but the numeration of the paragraphs is not sufficiently prominent for easy reference.

A Manual of Beekeeping: for English-speaking Beekeepers. By E. B. Wedmore. Pp. xxiv + 413 + 8 plates. (London: Edward Arnold and Co., 1932.) 15*s.* net.

IN 1563, Thomas Hill wrote "A profitable instruction of the perfite ordering of bees". Since that time the stream of manuals for the use of English-speaking beekeepers has been continuous. The present work is intended as a practical handbook

for use in the apiary and is conveniently arranged for this purpose. To avoid needless repetition, cross-references are freely used, but not in such a way as to become exasperating.

The author has been wise in leaving matters of anatomy and physiology to books primarily devoted to those subjects. He is at his best when giving directions for the carrying out of some operation of practical beekeeping. His instructions are precise and to the point, and much of the information given is most conveniently tabulated. 'Manipulation' is a word beloved by beekeepers, and if a tithe of the operations here detailed were carried out, beekeeping would cease to be profitable, but the author gives us a timely word of warning: "*The skilled beekeeper is known by the small number and apparent simplicity of the manipulations he employs*". (The italics are his own.) Nevertheless, the directions for dealing with an emergency when it arises are to hand in these pages. The sections dealing with biological matters such as the underlying principles of swarming and the causes and diagnosis of bee diseases are less happy; while the lists of honey plants are necessarily sketchy and compiled from other sources.

The information given is intended to be generally applicable, and an attempt has been made to do justice to the conditions and practices of the honey-producing regions of Canada, New Zealand, and Australia.

The volume is singularly free from the expression of pet theories and prejudices such as mar so many books on bees. The figures are good and illustrate points in the text. The binding is of a practical and durable type, as it will need to be if the book is to be used in the way that is intended.

D. M.

Borstalians. By J. W. Gordon. Pp. 284. (London: Martin Hopkinson, Ltd., 1932.) 7*s*. 6*d*. net.

THIS is an interesting, useful, and on the whole well-written book. It appears at a time when outbreaks of crime, especially in the United States and to a certain extent in England, have made methods of prevention even more urgent than methods of detection and punishment. Mr. Gordon reveals with intimate knowledge and sympathy the methods employed now for a good many years at the five Borstal institutions in England. It is an encouraging picture, and being drawn with a frank and critical hand, carries the more conviction. He was himself an inmate at the Feltham Borstal and, having made good afterwards, largely through the interest and generosity of an American friend, was able to revisit the scenes of his early training, recall his own experiences, and note subsequent changes. He also visited the girls' Borstal at Aylesbury, and seems to have marched with the new colony which swarmed off a year or two back from Feltham to Lowdham. This forms one of the most attractive episodes in the book.

Criticising his own criticism, one is inclined to ask whether more might not be done in the way of stimulating intellectual interest, encouraging reading and providing classes and lectures, as well as the excellent work done by sports, games, badges, houses, etc. The girls seem to be better looked after in this respect. Perhaps women generally are less inclined to be frightened by the damning appellation of 'highbrow', a word and an idea that are doing a world of mischief.

F. S. M.

Breeding and Care of the Albino Rat for Research Purposes. By Milton J. Greenman and F. Louise Duhring. Second edition. Pp. 121 + 6 plates. (Philadelphia: The Wistar Institute of Anatomy and Biology, 1931.)

THIS book gives a clear and detailed description (with diagrams) of the housing, feeding, and behaviour of a colony of rats which has been in existence at the Wistar Institute for some twenty-four years. Thus the various points recommended are the result of much experimenting and long experience, which make them of real value, though some of the arrangements for housing appear to be unnecessarily elaborate. In addition, details of cages and water vessels, etc., in use and found suitable in other laboratories are given. Chapters on the parasites and diseases specially likely to attack the albino rat are also included. Special stress is laid on the advantages of 'gentling' the rats by frequent handling and of giving them opportunities for exercise, a point too often overlooked in breeding rats for experimental purposes. The importance, too, is emphasised of making full records of growth and fertility of the colony from time to time, so that any possible deterioration may be rectified.

The book will be of particular value to research workers who are starting a colony of rats, and it cannot fail to interest also those workers who may have a colony already established.

Theory of Simple Structures. By Prof. T. C. Shedd and Prof. J. Vawter. Pp. x + 345. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 22*s*. 3*d*. net.

SO many textbooks have been written on the subject of structural statics that it must have become a somewhat difficult matter to find any fresh aspect of presentation. The authors of the present work, however, very properly and consistently emphasise the application of fundamental principles to all constructional problems, and this attitude constitutes the keynote of their treatment. They deprecate merely graphical methods, which "have a tendency to leave the student with the memory of a method of construction and only a vague notion of the principles involved". Certainly, they have produced a very clear and concise exposition of the subject, which students should have no difficulty in assimilating, while the abundance of problems set provides an ample field for testing the knowledge acquired. Written by two American university professors, the purview of the photographic illustrations is largely trans-Atlantic, but the examples are interesting and helpful, while the diagrams generally are very clear and comprehensible.

B. C.

The Scope and Needs of Medical Research *

By Sir WALTER M. FLETCHER, K.B.E., C.B., F.R.S.

THE phrase 'medical research' covers an immensely wide field of scientific activity in which workers of many different kinds are occupied. It is concerned directly and indirectly with the welfare of the bodies and minds of human beings, and if properly treated it must be a subject of the first interest to any human audience. The word 'medical' in this relation is likely to mislead. Strictly it refers only to the healing of disease, and it calls to our minds at once a vision of doctors at the bedside and of their drugs or implements. Yet as we use it here it has a scope, not only in the work of original investigation but also in preparing its results for practical application, which is indefinitely wider than that of the healing profession as such.

I can give an actual definition of the real scope of medical research in formal terms. It is a formula which has been adopted by His Majesty's Government to define the field of medical research work to which an annual Parliamentary grant-in-aid is made, and it is in these terms: "Medical research deals with the proper development and the right use of the human body in all conditions of activity and environment, as well as with its protection from disease and accident, and its repair".

Let us take each phrase of the definition in turn. The development of the human body: here we have to consider both nature and nurture, both inheritance and nutrition. Dangerous as it is in scientific studies to separate these sharply in our minds, as is so often done, each, nevertheless, is served by a special scientific discipline. One is served by the science of genetics and the other by the science of nutrition.

The science of genetics is still in its first infancy. By an easy effort of imagination we can form almost illimitable hopes of betterment in body and mind that fuller knowledge in this subject may hold out to the human race. Dreams of this are so attractive and may be so vivid as to tempt us to propose short cuts to make them real. Hasty practical proposals made in the name of what is called 'eugenics' are put forward. Many of these are based on obviously false assumptions, as, for example, that particular parts of the community are not desirable breeding stock, merely because at present they are inadequately fed; or, again, that the qualities which make many men rich are the qualities which we should desire to multiply in our race. Quite apart from witless social prejudices of that kind, the very machinery proposed for attaining the results desired has often no basis at all in scientific knowledge. Yet in this field some of our highest hopes for man's future may still reside. We have evidence already that the knowledge we have gained of the laws and machinery of inheritance in the lower animals holds good for man. Small beginnings are being made already by the studies of selected pedigrees, the use of probability laws, the examination of correlations between characters either directly observable or detectable by refined methods of blood examination—all these give growing hopes of our being able to map out the distribution of factors in the human chromosomes, those minute carriers of inheritance in the parent cells. Medical knowledge has a leading part to play here, for the most hopeful clues now in sight depend upon closer medical study of the inheritance of disease and abnormalities in family history. We are in practice cut off from the method of experimental mating in the study of human inheritance, and must perforce use the methods of medical observation and analysis of pedigrees. The work in sight is vast and may occupy many generations. All the more important then that it should begin early. There is no short cut to the power for human welfare that we may hope some day to gain by genetic knowledge. The only road to this has to be cleared up by persistent effort in this primary branch of medical research.

The other side of the study of the development of man's body, that of nurture, lies in the field of nutrition, and here there is a very different story. This study is concerned in part with the quantitative study of the energy requirements of the body and in part with the qualitative values of diet. It has only been a branch of exact science for the last generation or two. Our knowledge upon the qualitative side, even of the very existence of the vitamins, so familiar by name now to all, belongs only to the last twenty years. Yet from the knowledge so far won in this field we have already gained practical powers of high value. I will return presently to this subject of nutrition to illustrate in more detail the value and interest of this part of the medical field.

Pursuing our definition, we now come, after dealing with the development of the body, to the problems of its right use—and its right use in all conditions of activity and environment. Here we deal with problems of personal hygiene, of sleep, of diet in relation to climate and to bodily activity. We have to deal also with an intricate group of problems belonging to industrial life. The industrial revolution and the introduction of machinery upon a great scale brought a host of new problems under this head. Individual craftsmen throughout the ages have found for themselves their own ways of working to the best effect, and of making the compromises needed for gaining the best output with the least fatigue and damage to health. The introduction of machinery and the gathering of workers into large factories came about with far too much regard to the welfare of the machinery and the magnitude of its output, and with far too little regard to the machinery of the bodies of the workers. The application of physiological knowledge in this field has been lamentably slow in coming. Most of the elementary problems of maintaining efficiency

* Friday evening discourse delivered at the Royal Institution on May 27.

in work and of the spells of rest needed for particular occupations of many kinds have been studied only within the present generation, after almost a century of waste, discomfort, and misery.

The War brought home to us our ignorance of this branch of medical study, though no other country had greater incentive, both in duty and in profit, to lead the way in its development. When the safety of our people depended upon the fullest output of war material and the maintained efficiency of the workers, it was found that we were ignorant, as a nation, of some of the most elementary laws of industrial health. We had to find and apply as best we could the optimum hours of work and the best use of rest pauses for different kinds of work, ranging from heavy physical labour to light manipulative tasks involving maintained attention to rapid machine processes. When the lives of men, or indeed of armies, might depend upon the rapid use of the spade in trench-warfare, it was found that nobody since Adam first used a spade had worked out the optimum rest-pauses for the best performance of a gang of digging men over different periods. Medical research had also to find new safeguards for men living in submarines below the sea, mining far into the earth, or flying to great heights in the air.

During and since the War, a great volume of research work has been done under the Industrial Health Research Board to clear up these problems connected with the right use of the human body. They deal with hours of work, heavy or light, rest pauses, shift systems, the problems of monotony in repetitive work; they have dealt with the human factor in the causation of accidents, with problems of ventilation, of lighting and heating, with all the special problems of vocational guidance and selection, with the study of body movements, posture, and physique in particular industrial processes, as well as with the special dangers arising from poisonous materials in particular trades or occupations.

We now come to the protection of the body from disease, and here we come for the first time to what is ordinarily thought of as medical work in its narrow sense. This part of the work falls, of course, at once under two main divisions. There is the work of preventing disease, and there is the work of curing or palliating disease when already present.

We can scarcely think, and have no reason to think, of disease as being caused otherwise than in one of three ways. There are diseases due to abnormalities of structure or chemical behaviour which are inherited and come from the genetic history of the individual. There are other diseases which are due to faults in the immediate environment of the body, early or late in its development, such as those, for example, known to be the result of imperfect nutrition. Lastly, there is a great variety of disease due to the direct attack upon the body by other forms of life in the shape of parasitic enemies.

We can aim at preventing inherited disease by increasing our knowledge of genetics and by regulating human mating. It will be very long before we have knowledge enough to gain much power in this direction, and how far we can use it when gained will depend upon our political structure and social habits. Already our genetic knowledge is enough to allow us to abolish at once one type of juvenile idiocy and greatly reduce other mental defects by regulation of marriages in the families displaying them.

Many diseases of environment are under our potential control already. Diseases like scurvy, beriberi, rickets, pellagra, are due to deficiencies of particular vitamins in the food. No doubt other abnormalities of body, including forms of mental weakness, will be found to be due to similar deficiencies, either in childhood or during embryonic life, and we know already, though not yet in enough detail, that deficiencies in diet diminish the resistance of the body to infective disease.

Lastly, we come to the great welter of disorders produced by the actual presence within the body of enemy parasites. These may be multicellular animals such as parasitic worms, unicellular forms such as the trypanosome of sleeping sickness, or the plasmodium of malaria; they may be bacteria, as in the infections of typhoid fever and pneumonia, or they may be minute bodies, barely visible by ordinary microscopes, which are the so-called 'viruses' causing diseases such as smallpox, measles, yellow fever, and so on. You have heard much of the great labours that have gone so far in giving us control over these enemies of our race, whether in tropical climates or at home. The work has involved clinical study of the diseases, intensive detective work to find out how the parasites are conveyed, whether by water, air, or soil, or by the intricate participation of insects and other carrying hosts. The study of these hosts and of the parasites themselves has been the work of zoologists in the field and in the laboratory, while the study of bacteria is a science by itself, with its specialised technical methods.

It is well known also that the knowledge gained here has already given us great powers in the prevention of disease, and an important part of the medical profession is devoted to their use in administration. I would only note here how random seems to be the relation of knowledge to power within this complex field. A very little knowledge of the infective agent concerned may give almost complete powers of prevention. We have the full power of preventing smallpox in any given man, or of distemper in any given dog, yet know much less about the nature of those viruses than about that of any other of the groups I have named. In malaria, on the other hand, we have a great deal of knowledge about the life history of the parasite and its mode of conveyance by the mosquito from man to man. We have the power of freeing any given community from the disease, but only if we have money enough to break the chain of events by getting rid of the mosquito carrier. We had this knowledge and this power a generation ago, yet there is more malaria in the world now than then, and it afflicts with its curse probably a third of the whole human race, with a death-rate of two million persons every year. What is needed now

is still more intensive research work that will allow us a more ingenious attack upon the parasite by methods which it may be practicable to use upon an immense scale at reasonable cost.

So much for preventive research. But protection from disease involves also its curative or palliative treatment; and here we come, for the first time, to the work of the medical profession as ordinarily understood, whether that of the physician or of the surgeon. When disease is beginning or has been established, the doctor is concerned to give his help in the most effective way to the single individual before him. This offers him an intricate set of problems which make his work a special branch of applied science in which high arts of skill are based upon the knowledge available. He cannot act effectively until he has found not only the nature of the disorder present but also its particular manifestations in that individual case. The very fact that he must avoid opening the body to look inside it has led to the development of intricate devices for observing and deducing the actual facts from the outside. I need not dwell upon the skill needed by the competent physician, nor upon the manipulative wonders now made possible to the surgeon by Lister's work: nor, again, need I do more than point to the high responsibilities undertaken by the physician or surgeon to whom a human life is entrusted. At every point their knowledge and skill depend upon the results of research work of many kinds, and their powers can only advance as research work progresses.

Lastly, there remains to consider, in the definition I am following, the protection of the body from accident, and its repair. The study of accidents has led to much profitable research work, of which some of the chief has been done under the Industrial Health Research Board. Accidents can be sorted out into those due to the unfitness of particular workers for given tasks, or to states of mind, or to conditions of fatigue and other states of the body, or, again, to the absence of proper protective devices and administrative rules. When their causation is accurately found, preventive work is at once rightly guided.

Under this last head, too, there is the skilled work of the surgeon in repairing physical damage done to the body. But we can only point to this here as completing our rapid survey of the whole campaign in the medical field. It is worthy of note that in coming to the end of this general story, we find ourselves close to the beginning of it again. Surgery has brought us near to the study of heredity again with which we started. For uncounted centuries the surgeon has repaired so far as possible the injuries of man's body in warfare and accident, and his chief concern has always been at least to prevent death by loss of blood. There is no more ancient surgical problem than that of whether a healthy man can lend some of his blood to save the life of another. Nearly three hundred years ago Dr. Lower of Oxford showed to King Charles II. and the early Royal Society that one dog's blood might be transfused into another dog to replace its own. But it has only been in the last twenty years that we have learned why it is that, while the blood of one man given to a patient who has suffered loss by bleeding may be fatal, that of another man may have no ill-effects and may restore life—and happily that knowledge came in time to save many thousands of lives in the War. Careful laboratory studies have shown that every human being belongs to one of four groups, distinguished by the different precipitating powers of their bloods, one against another. These subtle blood differences, far more subtle than any chemical analysis could detect, are of daily importance in surgery. They play a part also now in the study of human inheritance with which we began this survey.

(To be continued.)

Oriental Studies in the University of Chicago *

IN the past ten years the United States have made remarkable advances in archæological research in both the New World and the Old. In America itself the whole range of continental civilisation in one form or another from Alaska to Peru has been brought under investigation by university departments and public or semi-public institutions. In particular, the activities of the Carnegie Institution of Washington in Central America and of the Smithsonian Institution in the south-western United States have contributed materially to the advancement of archæological science through the intensive studies by means of which they are gradually filling in details of the chronological sequence in the development of culture in these areas.

In the Old World, both independently and in cooperation with European scientific bodies, American archæologists have extended their activities over a wide area. The American Schools in France, Athens, and Jerusalem and the expedition of the University of Pennyslvania, in conjunction with the British Museum, at Ur have achieved results of signal importance in the investigation of the history of man and his early civilisation. Less widely known, perhaps, but not of less moment, are the operations of the Oriental Institute of the University of Chicago, of which some account is given in a recent publication issued in commemoration of the opening of new buildings.

When the Oriental Institute was created by the trustees of the University of Chicago and organised by Dr. J. H. Breasted in 1919, its aim was to become "a research laboratory for the investigation of the early human career", and to trace "the course of human development from the merely physical man disclosed by the palæontologist to the rise and advance of civilised societies, the product of social and material evolution culminating in

* The Oriental Institute of the University of Chicago: in Commemoration of the Dedication of the Oriental Institute Building, Dec. 5, 1931. Pp. iv + 68. 25 cents.

social idealism ". It was felt that the proper field for its operations could be only the Near East, the region around the eastern end of the Mediterranean. The formation of the Institute was made possible by the generosity, first of John D. Rockefeller, jr., and then of a number of other benefactors. Field expeditions were sent out and the work of the Institute rapidly outgrew the capacity of its first headquarters in Haskell Hall. In April 1930, ground was broken for a new building, which was completed in April 1931. In this the work of the Institute is now installed and completely equipped for its threefold activities of work in the field, study in the laboratory, and the publication and dissemination of results.

In the field, the Institute now maintains twelve expeditions, engaged in collecting original evidence relating to the origin and development of civilisation. Of these, six are concerned with ancient Egypt, two with Iraq, and four are distributed in Anatolia, Syria, Palestine, and Persia respectively.

In Egypt the work of the six expeditions, though not all are engaged in actual excavation, is so distributed as to cover the development of Egyptian civilisation from the very earliest times to the nineteenth dynasty, or even beyond. The Prehistoric Survey under Dr. Kenneth S. Sandford of Oxford has made a detailed investigation of the Nile valley, finding the earliest evidence of man yet discovered in the Near East at the bottom of the gravels of the former Nile valley, and determining the date of the desiccation of North Africa and the formation of the Sahara. At Sakkara, the expedition under Prof. Prentice Duell has launched a programme for the complete record in five folio volumes of the great treasury of relief paintings in the masonry tombs of the cemetery of ancient Memphis. After nine years' work, Dr. Alan Gardiner and Dr. A. de Buck have completed the copying of the Coffin Texts from Middle Kingdom burials, which are essential for the study of the Book of the Dead. These are now being edited and will be published in a series of five volumes. In association with the Egypt Exploration Society, the Institute is saving the records of the beautiful temple of Seti I. at Abydos, "the loveliest works of art of the ancient world". These will also be published, mostly in colour, under the editorship of Prof. Gardiner, while the work is being carried on by Miss Amice M. Calverley, assisted by Miss Broome. Mrs. N. de G. Davies is also engaged in copying, in colour, paintings in the tombs of the great Theban cemetery. These paintings, together with series previously painted by Mrs. Davies for Dr. Gardiner, are to be published, the first volume appearing in 1932.

At ancient Thebes the Institute has its largest undertaking in the Near East, in the Epigraphic and Architectural Survey Expedition. The work of this expedition was begun in 1924–25, and with it is now combined the headquarter work of the Institute, for which a new building, in California-Spanish style, has recently been erected at Luxor. For seven years this expedition has been at work on the colossal temple of Medinet Habu and associated structures under Prof. Uvo Holscher. These excavations have revealed the surprising fact that the largest halls of the palace of Rameses III. had vaulted ceilings and were not flat-roofed as were the temples.

In Western Asia, as in Egypt, the work of the Institute has been planned on lines which are at once comprehensive and at the same time admit of expansion without danger of overlap and waste of effort. Two expeditions are working in the "Highland Zone" under the general direction of Dr. H. Frankfort. Four mounds are included in the concession which the Institute holds from the Government of Iraq. Of these mounds, Tell Asmar (Ashnunnak) is the most important. Here extensive headquarters have been erected. A large palace of Sumerian age has been discovered, of which the excavation is to be completed in the current year; while on another mound at Khafaji, about ten miles away, a large fortified enclosure with temples and dwellings has been uncovered. South of the "Highland Zone", where the cities and palaces of the Assyrians are important sources for evidence of a composite culture which draws its material from both north and south, the Institute is excavating the palace of Sargon II. at Khorsabad. Here Dr. Edward Chiera is following excavations begun by the French more than eighty years ago. Many valuable relief-sculptures have been discovered, including a huge winged bull, partly in the round, which, on the allocation of the Iraq Government, has been brought to Chicago.

In Anatolia, excavations on the Hittite city mound of Alishar in 1930 and 1931 have added this as the third of the sites on which clay tablets of Hittite cuneiform have been found. This expedition has done pioneer work in plotting the archæological levels, with the result that the careful listing and sequence identification of types makes available for the first time a history of the pottery in Hittite territory. A discovery of which the precise significance is as yet difficult to forecast is the apparent survival to-day of ancient Hittite speech in a small isolated village of Anatolia. It has been recorded by Dr. J. Mészáros, of the Angora Museum, and is to be published by the Institute.

In Syria, exploration has identified an ancient mound as the city of Calneh, to which reference is made by the prophets Amos and Isaiah as one of the Assyrians' greatest enemies in the west. A concession for the excavation of this site and a neighbouring mound has just been granted by the French authorities under their mandate. Headquarters are being erected and work will be begun on the two mounds simultaneously. The Palestinian expedition is occupied in the investigation of the city of Megiddo, one of the most important of strategic points in the history of the country. The Institute has recently acquired control of the whole site, an area of more than thirteen acres, and is now stripping off systematically stratum after stratum of the deposits. Up to the present, the expedition has descended to the stratum of the Hebrew kings. The finds included the stables in which Solomon kept the blooded horses imported from Egypt for

sale to the Hittites. An interesting innovation in the work on this site is the employment in air photography of a small captive balloon which carries a camera operated from the ground. Its use is fully described for the first time by Mr. P. L. Guy in *Antiquity*, June 1932.

A concession from the Persian Cabinet to explore and restore the palace of Persepolis has been inoperative until recently owing to lack of funds; but a generous anonymous donation has now made it possible to begin work. Dr. E. Herzfeld, of the University of Berlin, has been placed in charge of the excavation. As a preliminary, and in order to provide accommodation for the expedition, six chambers in the palace have been cleared. These chambers have afforded some interesting material, which *inter alia* indicates that they had once been part of the quarters of the harem of Darius.

Of the activities of the Institute in research and publication in Chicago, no more can be said here than that they keep fully abreast of the strenuous work of the expeditions in the field in dealing with the original material, and at the same time foster inquiry on other and cognate lines. Throughout its activities the characteristic feature of the work of the Institute is the breadth of vision with which its operations have been planned, combined with a singleness of direction towards the aim which was marked out for the Institute at its inception. It is scarcely necessary to indicate to what an extent in this, as in other matters, the Institute is indebted to its director, Dr. J. H. Breasted.

Obituary

M. Santos-Dumont

The death at São Paulo, Brazil, on July 23, of M. Alberto Santos-Dumont, at the age of fifty-nine years, removes another of the few remaining pioneers through whose efforts mechanical flight was achieved. Santos-Dumont was the first in Europe to make a public flight in a heavier-than-air machine, while his numerous experiments with dirigible balloons stimulated the progress of airship construction. His enthusiasm and intrepidity led him into many adventures, and his flights with small airships in the neighbourhood of Paris some thirty years ago made his name famous throughout the world.

Santos-Dumont was born on a large coffee estate at São Paulo on July 20, 1873, and it was during a visit of his family to France in 1892 that he began his work on dirigible balloons. By 1898 he was in possession of his first airship, and during the next few years he constructed about a dozen of various sizes, driven by internal combustion engines. With one of these, on Oct. 19, 1901, he made a flight from St. Cloud around the Eiffel Tower and back, in 29½ minutes, and thus secured the prize of 125,000 francs offered by M. Deutsch de la Meurthe. To commemorate the event, the Brazilian Government struck a special medal. The airship in which the feat was accomplished was of 22,000 cub. ft. capacity, and was driven by a 12 h.p. engine. During his experiments Santos-Dumont had many narrow escapes, and on one occasion had to be rescued from the roof of the Trocadero by firemen. His airships were all of the non-rigid type.

From the airship Santos-Dumont next turned to the aeroplane, then engaging the attention of the Voisins, Ferber, Archdeacon, Blériot, and others in France. Though familiar with the gliding experiments of Octave Chanute, little was yet known by workers in Europe of the aeroplane of the Wright brothers and of their historic flights in December 1903 at Kitty Hawk, South Carolina. By the beginning of 1906, however, Santos-Dumont had constructed a biplane with wings of box-kite form, and with this machine, on Aug. 22 that year, made the first public flight on record in the Old World. The same year he made other short flights. The machine was called *The Bird of Prey*. "Its main double-decker planes", wrote Miss Gertrude Bacon, "were tilted up at a considerable angle. There was no tail, but in front a big box-kite elevator; so that the thing appeared to fly tail foremost, or as someone said, like a duck with its neck outstretched. On a light, open framework in the midst, mounted on bicycle wheels, was the 50 horse-power Antoinette motor, driving the propeller at the back, and the sort of wicker waste-paper basket in which the aviator stood."

According to the *Times*, M. Santos-Dumont will be buried in the family vault at São Paulo, over which a monument will be erected identical with that set up some years ago at St. Cloud to mark his historic flight of 1901.

Prof. A. Humboldt Sexton

Prof. A. Humboldt Sexton died on June 21, at Jersey, at the age of seventy-eight years, after a long illness. He was the eldest son of Dr. George Sexton, who was well known in his time as a lecturer on spiritualism and later as a Christian apologist, and he was educated at private schools and the Royal School of Mines. He obtained a Royal Exhibition tenable at the Royal College of Science, Ireland, in 1871. In 1873 he became assayer to the Mining Company of Ireland, and in the following year was appointed chemist to the Broughton Copper Works.

Appointed science master to the Wedgwood Institute, Burslem, in 1881, in the following year Sexton became lecturer in chemistry and metallurgy at the Manchester Technical School. Two years later he was appointed professor of metallurgy at the Glasgow and West of Scotland Technical College, a position which he held until his retirement in 1909 with the title of emeritus professor.

Prof. Sexton was a past-president of the West of Scotland Iron and Steel Institute, and his numerous books on chemistry, metallurgy, and refractories were well known and much used in schools and colleges. He also published many papers in technical and scientific publications.

Upon his retirement, Prof. Sexton became Minister of the New Church at Jersey, and afterwards held a similar appointment at Liverpool and Northampton. He gave up the latter post in 1923 and returned to Jersey.

PROF. W. W. KEEN

PROF. WILLIAM WILLIAMS KEEN, who died on June 7 at the age of ninety-five years, gained his reputation as a surgeon during the American Civil War, and for a period of more than fifty years thereafter was recognised as the most outstanding figure in American surgery. He was a contemporary of Oliver Wendell Holmes, and like him had uncommon gifts of personality and scholarship. His textbook on surgery enjoyed a world-wide reputation for many years, and made his name known far beyond the University of Pennsylvania, in which he taught, and the city of Philadelphia, in which he practised.

Dr. Keen was one of the first to adopt and apply to surgery the principles and practice of Listerism. He was a scientific surgeon in so far as it is yet possible for a surgeon to be guided by scientific principles, and although the author of innumerable contributions to surgical literature, all of which added something to the subject dealt with, yet it was his personality and general proficiency rather than his originality in any particular field which gave him the high place he enjoyed for so many years.

Dr. Keen recognised that surgery depended for its advance on the growth of the basal subjects of medical education, particularly of experimental physiology, and never wearied in his defence of vivisection and of temperance. Like the late Sir William Osler, he was a bond between the medical professions of the United States and of Great Britain.

WE regret to announce that Miss Adelaide Ames, research assistant in the Harvard Observatory, was drowned in a canoe accident in Squam Lake, New Hampshire, June 26, at the age of thirty-one years. Her scientific work, thus suddenly ended, had already gained for her a wide recognition. She was a member of the Commission on Clusters and Nebulæ of the International Astronomical Union. For several years Miss Ames had carried on investigations in the field of extra-galactic nebulæ, her principal publications dealing with the Coma-Virgo cloud of galaxies. Her most important work was in connexion with a photometric survey of all extra-galactic objects to the thirteenth magnitude —a census of the inner parts of the metagalaxy to a distance of five to ten million light-years. This survey was completed in June and will be published during the next month in collaboration with Dr. H. Shapley.

WE regret to announce the following deaths:

Dr. Geo. K. Burgess, director of the U.S. National Bureau of Standards, and treasurer since 1924 of the National Academy of Sciences, on July 2, aged fifty-eight years.

Prof. Matthew Hay, emeritus professor of forensic medicine in the University of Aberdeen, formerly medical officer of health for the city, on July 30, aged seventy-six years.

Prof. John R. F. Sebelien, formerly professor of chemistry in the Agricultural College, Aas, Norway, known for his contributions to the chemistry of milk and dairy feeding and artificial manures, aged seventy-four years.

Sir William Willcocks, K.C.M.G., the distinguished irrigation engineer whose name is associated with the Assuan dam and the Assiut barrage in Egypt and with irrigation work in Mesopotamia, on July 28, aged eighty years.

News and Views

Dr. P. A. M. Dirac

DR. P. A. M. DIRAC, of St. John's College, Cambridge, has been appointed to succeed Sir Joseph Larmor when he vacates the Lucasian chair of mathematics at Cambridge on Sept. 30 next. Dr. Dirac has been one of the most notable of the group of young physicists (mostly within a year or two the same age) who have, during the past seven years, created quantum mechanics. After graduating at the University of Bristol both in engineering and in mathematics, he entered the University of Cambridge as a research student in the Faculty of Mathematics, and may perhaps not unreasonably be accounted fortunate in his time, for he was in the middle of his course for a research degree when the ferment of dissatisfaction with the limitations of the older quantum theory was at its height, and the great blaze of theoretical advance was set alight by Heisenberg's first paper of the autumn of 1925. Dr. Dirac was one of the first to see clearly how the new ideas were to be extended and formalised, and his own researches have played a great part in both these processes, especially in formalisation. His unpublished degree thesis was probably the first such attempt to present in any detail in a consistent and logical way the revolutionary new theory. Later he published a much expanded and revised form of this attempt in his well-known book on quantum mechanics. His most strikingly original and successful contribution to the whole theory is his relativistic theory of the electron, a contribution in which his great mastery of and instinct for form has guided him at once to the correct generalisation. Dr. Dirac will succeed to the Lucasian chair when he is just over thirty years of age, with the acclaimed consent and good wishes of all his colleagues in mathematical physics in Great Britain. His University may look forward to another long and distinguished tenure of a chair to which long and distinguished tenures are by no means unfamiliar.

New Skull from South Africa

PROF. DUBOIS' comment on the skull recently discovered at Ngandong, Java, and its relationship to Rhodesian man, which appeared in NATURE for July 2,

p. 20, enhances the interest with which anthropologists will await further particulars of the human skull which, it is announced, Prof. T. F. Dreyer, of Grey University College, Bloemfontein, has discovered at Florsbad hot springs. According to a message in the *Times* for July 27, Prof. Dreyer has found parts of a human skull and a tooth, associated with stone implements of a primitive type and the remains of extinct fauna on this site, which lies twenty-five miles north of Bloemfontein. The lower jaw is missing, but, it is said, most of the facial bones are present. The character of the skull cannot be determined with certainty until the base has been found; but Prof. Dreyer is reported to be of the opinion that it is that of either Neanderthal man or Rhodesian man. According to the measurement of the skull "over the eyes", it would hold a place intermediate between the two, the figure given being 130 mm., as against the maximum in Neanderthal man of 125 mm. and 139 mm. in Rhodesian man. These figures, slender evidence as they are, are certainly suggestive of the possible significance of the new find in relation to the affinities of early types of man in South Africa. Should it appear eventually that the skull is a second specimen of Rhodesian man, its association with stone implements and extinct fauna should provide the much desired evidence indicating the geological age and the culture of that remarkable type of primitive man.

Exhibition of British Archæology

An exhibition illustrative of recent field-work in British archæology was arranged at the London Museum in connexion with the International Congress of Prehistoric and Protohistoric Sciences which met in London on Aug. 1-6. Its primary object was to afford visitors from abroad some idea of the range and value of the material which archæological investigation in Great Britain is adding to the study of prehistoric and early historic times; but it was also intended to interest and inform other visitors to the Museum whose acquaintance with archæological studies might not be sufficiently intimate to keep them abreast with the activities of our research workers in the various provinces of the subject. The exhibits ranged from the pre-palæolithic discoveries of Mr. Reid Moir in East Anglia to the objects of late Saxon and Viking times from districts so far removed from one another as Durham and Dorset. The choice of sites illustrated was discriminating and the number of objects shown kept as low as possible, consistently with the aim of making the exhibition representative. It is, therefore, difficult to single out any one or two exhibits as especially worthy of note. Colchester and Verulamium naturally figured prominently, as also did Mr. A. Keiller's exhibit from the Windmill Hill site. No doubt many visitors were glad to avail themselves of Mr. Keiller's offer of admission to view the complete collection of finds shown at Charles Street, Berkeley Square. The interest of the exhibition was much enhanced by the magnificent series of photographs from the air of various classes of site which was lent by the Ordnance Survey and described in an admirable catalogue. An excellent descriptive catalogue was also prepared for the archæological exhibits. Probably it will be a long time before so completely representative a collection, drawn from widely distributed places of permanent exhibition, will be gathered together again.

Methods in Anthropometry

For a considerable period it has been apparent that the time was ripe for a measure of revision of the methods of anthropometry, although caution was enjoined by a not unnatural reluctance to take any steps which might lessen the value, for comparative purposes, of thousands of measurements taken by generations of anthropologists in the field and laboratory. The feeling of dissatisfaction with existing methods, however, both among British and Continental anthropologists, was sufficiently strong to warrant discussion; but it cannot be said that anything practical had emerged until recently, when certain suggestions were put forward jointly by Miss M. L. Tildesley, Dr. E. G. Morant, and Dr. L. H. Dudley Buxton as a report to the council of the Royal Anthropological Institute. Briefly, these suggestions are that for the moment there should be an agreed abbreviated technique of observations in anthropometry, confined to the racial characters of adults of both sexes; and that this should be determined and elaborated as required by an international committee. But it is put forward as a first step that a technique should be formulated for Great Britain and Ireland; and at the same time representative bodies in other countries should be invited to do the same for their areas, with the view of international discussion later. The proposal, with further suggestions as to detail, will be found in *Man* for July. While this courageous attempt to deal with a difficult situation scarcely calls for comment at the present stage, it may be pointed out that without an assurance of external support the proposal risks a great deal of wasted effort. British anthropologists cannot work in isolation, however considerable the proportion of their output in the world of anthropometric science may be.

Changes in Scientific Outlook

Sir Oliver Lodge on March 17 gave the oration at the thirty-sixth Foundation Week at University College, London. It was well received at its delivery, and is well worth reading in its published form (University of London Press, 1*s*. net). Sir Oliver is now so generally accepted as the best exponent of a tolerant, humane, and comprehensive way of regarding science that when he speaks, as he did, on "Changes in Scientific Outlook", he might expect an attentive audience. The address was eloquent, impressive, and highly stimulating to thought, but it scarcely covered the matter which the title would lead one to expect. There is little or nothing in it of the latest developments in science, the extension of specialisation, the connexions of astrophysics with laboratory work, the exploration of the border-line problems between animate and inanimate. Sir Oliver practically confined himself to the one issue which in his view outweighs in ultimate importance all the others, and the address might well be called "A Plea

for the Spiritual in the Realm of Science ". The spiritual in this case is not to be identified with the 'spiritual' which Sir Oliver has so closely and patiently pursued in the purely human sphere. He has, as always, a word on this topic, and pleads for the open mind, a plea which every fair-minded person will be willing to support. But he goes on to speak—and it is the burden of his speech—of the need of admitting a spiritual explanation of the phenomena of the world as a whole.

Spiritual Elements in Science

Sir Oliver is arguing throughout with those who maintain the strictly scientific or agnostic attitude, and in doing so he postulates what he calls " spiritual elements " or a " spiritual influence ", which at the end of his discourse he weaves into " the one Reality which gives meaning to the existence of the whole material world . . . and illuminates the whole universe with Immortal Love ". It is a fine passage, which takes us back to the triumphant finale of Dante's " Paradiso "—but one is bound to recognise that it is a supreme act of faith, an apotheosis of the Unknown rather than any extension of the scientific outlook. Science, *qua* science, will agree with Sir Oliver that the mere fact of the human mind attaining the power of prediction—forming, that is, scientific laws—proves that the universe, as presented to us, acts in an orderly or rational way. It will also agree with him that the progress of the human mind exhibits the development of truth, beauty, and love. But when he proceeds to evoke and apply these conceptions—as he frankly does—at any point in the story of evolution where scientific knowledge fails, one sees a danger and remembers the famous Hippocratic diagnosis of the sacred disease the 'sacred disease' was that of which men had not yet discovered the natural cause. Our religion should inspire and encourage, but, above all, it must not relieve us of the primary duty of following the truth into its most remote retreat.

World Agricultural Policy

The general assembly of the International Commission of Agriculture, which met at Lausanne on July 21–22, was attended by delegates from sixteen countries and thirty-five national agricultural organisations, and a statement has been issued on world agricultural policy. It was emphasised that the world agricultural crisis is due to the fact that production and the increased means of securing production have outstripped both present consumption possibilities and population increases, while purchasing power has meanwhile declined. The Commission therefore considers that a judicious organisation of production and exchange will constitute one of the most effective means for fighting the agricultural crisis and establishing the prosperity of nations on a new basis. The first step would be to substitute orderly marketing, through the agency of associated bodies or by means of systematic State-controlled quota import arrangements, for the present unregulated offers of large quantities of commodities on world markets. Simultaneously, all means of stimulating consumption in general will have to be considered. Efforts will have to be made to improve and regularise quality and to cheapen retail sale. An appropriate wages policy will have to be adopted which, while allowing of a decrease in the number of the unemployed, will take account of national purchasing power. The question of new markets should also be studied, and, for the time being, also that of the export of existing surpluses to countries where the populations are suffering from underfeeding or famine. Further, an increased consumption of products of animal origin would absorb a larger portion of the surplus of vegetable products, which would be transformed into milk and meat. Finally, building should be encouraged by all suitable means. The International Commission of Agriculture recommends agriculturists to support the work of international collaboration, to associate themselves with efforts which aim at the maintenance of peace, at guaranteeing the security of property, and at drawing closer the bond which unites economic groups and nations in a common interest.

International Scientific Centres in Paris

La Maison du Savant, which is to be built in Paris, will be a well-appointed meeting-place for French and foreign men of science, if the present plans come to fruition. Lecture rooms, restaurant, winter-garden, and other amenities will be at the disposal of members and visitors. In addition, it will possess an extensive office of information which will study projects for the erection of up-to-date laboratories and research institutions, and organise congresses, exhibitions, conferences, and all publicity necessary to attain the organisation's aims. An illustrated periodical will also be published eventually, to inform the public of the general progress of science. Other activities include a benevolent fund and the provision of scholarships. The Maison du Savant is under the patronage of M. Lebrun, President of the French Republic; it has received government support, and its honorary committee consists of a distinguished group of academicians, including MM. le Chatelier, Charcot, le duc de Broglie, Richet, etc. Its founder and president is M. Georges Lecuyer, president of the International Union of Decorative Arts, and its active director is M. Jean de Chappedelaine. The organisation hopes to raise fifty million francs in the near future for its extensive programme. Through the official support of the Chamber of Deputies and the Municipality of Paris, a beginning has been made with convenient office rooms at 5 Avenue de l'Opéra, Paris.

" La Maison Internationale de la Science " is a project put forward on the occasion of the Colonial Exhibition of last year, during an international congress of men of science and research workers, for the furtherance of their interests. Its temporary headquarters are at the Institut Marey, Avenue Gordon-Bennett, Paris. It has not been very active, owing to the absence of its director, M. Pélissier, on a government mission to the island of Réunion; in all probability it will join forces with the Maison du Savant. " Le Foyer International Universitaire " is a centre

planned by the University of Paris. It was to be housed in part of the hôtel de la Rochefoucauld d'Estissac; this, however, has been bought by the "Maison de la Chimie" (see NATURE, June 11, p. 865) for three million francs, which will be used by the "Foyer International Universitaire" to acquire another building in rue de la Four (the former École de Bouffémont). "Le Cercle Universitaire International" is a club projected by the Associations of University Students to receive visiting colleagues and university men and to organise meetings and lectures that will promote international friendship. Its president is M. Paul Langevin, and its temporary address is at the Musée Pédagogique, 41 rue Gay-Lussac, Paris.

Institut International de Documentation

THE eleventh Conference of the Institut International de Documentation (formerly de Bibliographie) will be held this year at Frankfort-on-Main on Aug. 30-Sept. 3. The Conference is open to all persons interested in the various aspects of documentation, that is, the collection, arrangement, filing, and indexing of graphic records. As in previous years, an attractive programme of papers has been arranged for presentation and discussion during the mornings, whilst the afternoons and evenings will be devoted to visits of inspection and recreation. The latter include visits to Darmstadt and Mainz, where State and municipal libraries will be inspected. The Conference fee of 12 R.M. includes all excursions. A special exhibition of technical appliances for library purposes (Adrema machines, photocopying apparatus, duplicating machines, metal furniture, etc.) has been organised in a room of the Conference building during the meeting. The programme of papers to be presented is not yet available, but copies of all papers will be distributed to members of the Conference prior to the opening session. Full particulars regarding hotels and accommodation and further details of the Conference may be obtained from the organising secretary, Dr. Schürmeyer, Direktor der Bibliothek für Kunst und Technik, Frankfurt am Main, or from the Secretary, British Society for International Bibliography, Science Library, South Kensington, S.W.7.

Sotheran's "Bibliotheca Chemico-Mathematica"

MESSRS. Sotheran, Ltd., have issued a first supplement to their "Bibliotheca Chemico-Mathematica" which was published in two volumes in 1921, and have again laid all students of science and technology under a debt of gratitude. The work pretends to be no more than a bookseller's catalogue, and does not, therefore, aim at completeness, but in fact it contains a most representative list of works, to the number of more than seven thousand items, of old writers in all branches of science, and a number of standard modern works. It is rendered of permanent reference value by the fact that the title-pages in the majority of cases are transcribed in full, and by the unusual wealth and scope of the notes that accompany most of the entries. One of the most interesting items (presumably to be sold as a whole) is a collection of more than eight hundred books from Newton's library, including copies of the first and second editions of the "Principia" with corrections, cancellations, and additions in Newton's handwriting—many of which were not incorporated in the later editions and would thus be of the utmost interest as showing the progress of Newton's thought—an annotated copy of Euclid, and many other works with Newton's autograph.

THE catalogue also includes a few books that belonged to Faraday and were bound and annotated by him, original copies of the first edition of Galileo's "Dialogo", a complete set of the Paris Academy's "Description des arts et métiers", with all its supplements, which is very rarely seen in the sale room—or the library—in its complete form, and, especially noteworthy, a copy of William Gilbert's "De Magnete", 1600, inscribed in what appears undoubtedly to be the autograph of the author, of which no other universally accepted example is known. The annotations are trustworthy and of great interest, and will save a great deal of searching through scattered authorities, the latest of whom appear to have been consulted. It is good to see that the title 'Honourable' is no longer given to Henry Cavendish, and it is to be hoped that Messrs. Sotheran's correction will finally destroy this persistent delusion. Prices appear to have risen since the date of the original catalogues, but remain moderate. Booksellers' catalogues are usually looked through rapidly for desired acquisitions, and if kept at all, are cut up for filing purposes, but the present volume is a bibliographical tool of value and should take its place beside its predecessors on the library shelf. It and the volumes still to come form a worthy memorial to the late H. C. Sotheran, to whom the volume is dedicated.

A New Periodical on Acoustics

THE rapid development of acoustics since the production of the thermionic valve is accompanied by so large an increase in the bulk of research papers that for some time the Acoustical Society of America has been publishing its own *Journal* devoted to the subject. A French journal, *Revue d'Acoustique*, is now to be published bi-monthly under the direction of a committee of well-known authorities. The first number, dated March 1932, wisely opens with a vocabulary, founded on that of the Committee on Acoustical Standardisation (*J. Acoustical Soc. of Am.*, **2**, No. 3), of acoustical terms with definitions and English equivalents, and authors are asked to indicate when they use a term with a different meaning. In addition to papers, abstracts longer than those usually available in *Science Abstracts* and a bibliography of papers and books published since 1925 are given. This latter section is classified under physiological acoustics, acoustic measurements, propagation, sound sources, sound receivers, music, mechanical music, noise and architectural acoustics, and books and general articles. The titles are given in French, with some inconsistencies of translation. Although a journal of acoustics will naturally be used

most by those interested in applied acoustics, several important general works published since 1925 might with advantage be included in the bibliography. The six books given are scarcely representative, sources in English being represented solely by the Physical Society's discussion on audition. A list of more than two hundred periodicals which are to be searched for the bibliography is given as a supplement. The address of publication is Les Presses Universitaires de France, 47 Boulevard Saint-Michel, Paris 5e.

Vocational Tests for School Children

THE City of Birmingham Education Committee has published the results of an investigation by E. Patricia Allen and Percival Smith into the value of vocational tests as aids to choice of employment (Treasurer's Department, Council House, Birmingham. 1*s.* net). Every child leaving school in Birmingham is carefully advised as to his future occupation, but it was felt that vocational tests might give the employment conferences more adequate data on which to base their suggestions. For the purpose of this experiment, the children leaving three schools were divided into two groups: one group was treated in the usual way, while the other was examined by special tests for manual, mechanical, and clerical ability, dress-making, and intelligence, and studies were added of social, medical, and temperamental conditions. The advice given was then based on the results. When the children had obtained work, there would be four categories, namely, the tested children who did and did not follow the advice, and the controls who did and did not. Evidence as to the progress of these groups in their industrial careers was then compiled over a period of two years. Although the report makes no extravagant claims, yet the general tendency was for the tested children, who were placed in accordance with the advice given, to be more satisfactorily placed than those in the other three categories. The writers report that a surprisingly large number of the parents had no ideas for their children, nor did the children as a rule know what they would like to do. The report is excellent, sufficient details being given, with the exception of the testing for temperament, to enable other workers to follow this up and use it for comparison. The results are in agreement with the previous London research.

Tung Oil in the United States

THE establishment of the tung oil industry in the United States has been so successful during the last few years that a move is now being made to expand it on such a scale that America will cease to be dependent on China for even small quantities of this commodity. Dr. H. A. Gardner has recently described the position in a paper before the American Chemical Society (Science Service, Washington). Tung oil is essentially an oriental product, used through the ages by the Chinese for making native lacquer and ink. It is manufactured from the seeds of a deciduous tree, *Aleurites*, native to China, on much the same principle as peanut oil is produced by milling from peanuts in that country. Seeds were first introduced into America through the agency of the U.S. Department of Agriculture in 1905, and planted at the Government Experimental Station then at Chico, California. Extensive plantings, however, were not made until some eight years ago in the southern States, which were so successful that already 25,000 acres of land have been given over to the industry. The American Paint and Varnish Association is particularly concerned with this venture, as the oil is a valuable ingredient of varnishes and varnish paints. Apart from those uses, the American industries have extended considerably the application of tung oil, and it is now employed in the manufacture of insulating compounds, brake linings, linoleum, waterproofing fabrics, as a binder for wall board and plastic synthetic lumber, primers, synthetic resins, battery jar compounds, aeroplane tubing fillers, and so on.

American Institute of Physics

FOR several years, a movement has been on foot in the United States to bring about co-operation between the several American societies devoted to physics and its more immediate branches. This has recently had its culmination in the formation of the American Institute of Physics, comprising the American Physical Society, the Optical Society of America, the Acoustical Society of America, the Society of Rheology, and the American Association of Physics Teachers. The purposes of the Institute are subject, of course, to natural development in accordance with the future needs of its founder societies. For the present, its principal activity is the publication of journals. The societies are delegating to the Institute the responsibility for publishing the journals which they have in the past sponsored themselves. The reason for this course of action is the promotion of economy and efficiency. The list of the journals includes the *Physical Review*, *Physics*, *Reviews of Modern Physics*, *Journal of the Optical Society of America*, the *Review of Scientific Instruments*, *Journal of the Acoustical Society of America*, and *Journal of Rheology*. The scientific editing of the journals remains the duty of the societies, while all the details in the handling of proofs, subscription records, book-keeping, and the like are undertaken by the Institute. Two important other functions have been assigned to the Institute, namely, the further co-operation with societies and agencies outside the founding group, and the extension of an information service to the Press. The central office of the American Institute of Physics is at 11 East 38th Street, New York City.

Manufacture of Insulators

THE *Vista* is a periodical published by the British Porcelain Co., Ltd., London, S.W.1, and deals mainly with subjects of interest to the electric power industry. In the May number it concludes a series of articles on insulator manufacture. Each piece of electrical porcelain is carefully inspected by factory inspectors immediately after removal from the kiln, and all pieces failing to pass this inspection are destroyed. To find the porosity, fragments of the porcelain are

placed in fuchsine dye and subjected to a pressure of two thousand pounds per square inch for twenty-four hours. They are then removed, carefully dried, and broken to find out whether there is 'penetration' or not. If any is noticed, the representative batch of insulators is destroyed. The thermal test consists in immersing the porcelain in boiling water and then in iced water for periods of ten minutes, one hot and one cold test constituting a thermal cycle. After five such cycles, the porcelain is flashed over to test for thermal failure. After further thermal cycles, the insulators are subjected to a flashover test. They are next subjected to a flashover test at a frequency of 250,000 cycles per second. This test has proved a boon to the industry, as it eliminates porcelain with dielectric defects. In assembling the insulators, Portland cement with a definite proportion of pure water is used. They are allowed to stand five days before being cleaned and treated with weather-proofing compound, and after three more days a routine tension test is applied. The final tests are made in the presence of the customers' inspector, who sees the large completed insulator subjected to a load of 10,000 lb. weight and to a high-frequency flashover.

The Census of India

In a paper read to the Royal Society of Arts on June 3, Dr. J. H. Hutton discussed some of the figures of the Indian census of 1931. Perfect accuracy in enumeration is not to be expected, and in this census there were certain unusual difficulties. From estimates based on those regions where the census was known to be incomplete for reasons that can be traced, it may be assumed that the deficiency for the whole of India is not more than one per mille. It was calculated that the normal increase in the decade 1921–31 should have been 8 per cent, or rather less if allowance were made for the last influenza epidemic and its inroads on population of the reproducing age. The actual increase, however, proved to be 10·6 per cent, a rate exceeding any previous record. The increase was greatest in the Native States and apparently has been most marked in the less fertile parts of the country, which is an indication of the pressure on agricultural land. In some cases, heavy increases have been due to an extension of irrigation. The lowest density came from certain districts of Baluchistan and the highest from part of Cochin, where the density exceeds even that of Java. There has been little change in the general proportion of urban to rural population. In 1931 the total percentage of urban population was 11·0 per cent as compared with 10·2 per cent in 1921. The proportion of females to males is falling and is now 940 females to every 1000 males.

Announcements

The Medical Research Council has appointed Mr. Ernest Bevin, Dr. C. G. Douglas, and Mr. W. S. Morrison, M.P., to be members of the Industrial Health Research Board in succession to Mr. Arthur Pugh, Prof. E. P. Cathcart, and Major A. G. Church, who retire by rota on Sept. 30.

At the quarterly *comitia* of the Royal College of Physicians of London held on July 28, the Bisset Hawkins Gold Medal was awarded to Dr. T. H. C. Stevenson for his work as superintendent of statistics in the office of the Registrar-General. It was also announced that the Harveian Oration will be delivered by Sir George Newman, Chief Medical Officer of the Ministry of Health and Board of Education, on Oct. 18.

At a meeting of the Council of the North-East Coast Institution of Engineers and Shipbuilders, held on July 22, the following medals were awarded: the Engineering Gold Medal to Messrs. L. J. Le Mesurier and R. Stansfield, for a paper entitled "Combustion in Heavy Oil Engines"; the Shipbuilding Gold Medal to Dr. F. H. Todd, for a paper entitled "Some Measurements of Ship Vibration"; the Thomas Fenwick Reed Medal, "for ability to take a share in the control of industry", to Mr. W. Spencer Paulin. The first Andrew Laing Memorial Lecture of the Institution will be delivered on Oct. 28, by Eng. Vice-Admiral Sir R. W. Skelton, Engineer-in-Chief of the Fleet.

It was announced at the annual meeting of the Wiltshire Archæological Society, which was held at Malmesbury on July 26, that the outgoing president, Mrs. M. E. Cunnington, in conjunction with her husband, Capt. B. H. Cunnington, had offered the nation the now famous prehistoric sites of Woodhenge, near Stonehenge, and the Sanctuary, near Avebury. These sites were purchased and excavated by Capt. and Mrs. Cunnington after their discovery from the air. They have since been fenced and the ring of post holes, in which the wooden, and in the latter wooden and stone posts, formerly stood, marked by low concrete pillars, showing the plan of the monuments. This generous offer has been accepted by the Office of Works.

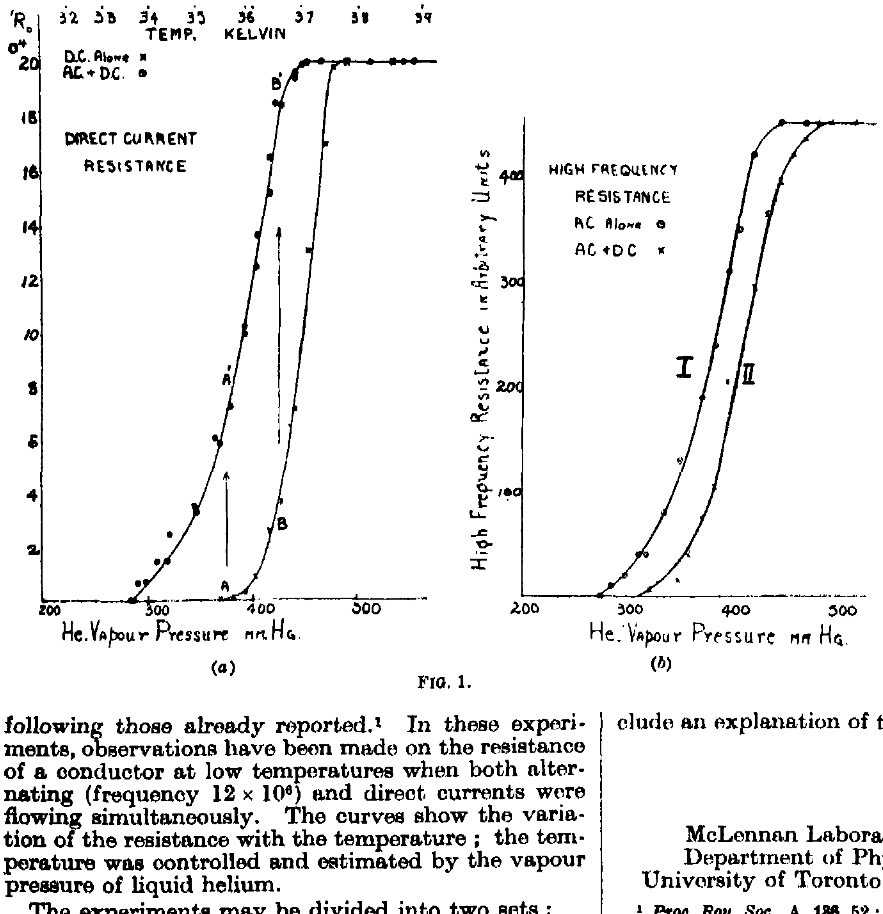
Applications are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer and demonstrator in civil engineering at the University College of South Wales and Monmouthshire, Cardiff—The Registrar (Aug. 8). An assistant for abstracting scientific and technical papers at the Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1.—The Secretary (Aug. 8). An assistant engineer in the Harbour Engineer's Department, Colombo Port Commission, Ceylon—The Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (Aug. 8). A curator at the Art Gallery and Museum, Doncaster—The Town Clerk, Town Clerk's Office, Doncaster (Aug. 9). Junior scientific officers in the Scientific Research Pool, Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Aug. 18). An engineering assistant for the Portsmouth Water Company—The Engineer, Water Company's Office, 26 Commercial Road, Portsmouth (Aug. 22). A principal at the Kadoorie Jewish Agricultural School, Mount Tabor, Palestine—The Chief Secretary to the Government of Palestine, Jerusalem (Aug. 30).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Superconductivity with High-Frequency Currents

FURTHER experiments have been carried out by us in this laboratory on the phenomena of superconductivity with alternating currents of high frequency, following those already reported.[1] In these experiments, observations have been made on the resistance of a conductor at low temperatures when both alternating (frequency 12×10^6) and direct currents were flowing simultaneously. The curves show the variation of the resistance with the temperature; the temperature was controlled and estimated by the vapour pressure of liquid helium.



(a) (b)

FIG. 1.

The experiments may be divided into two sets:

(a) The resistance offered to direct currents by the metal (tin) was measured both with and without accompanying high frequency currents.

(b) The resistance offered by the same sample to high frequency currents was measured both with and without accompanying direct currents.

The resistances of the conductor to direct currents and to high frequency currents were measured by independent methods, as indicated in the paper referred to above.

The results may be stated thus:

(1) (Fig. 1 (a)). Curve *AB* represents the relation of R/R_0 and temperature (Kelvin) for direct current. When, in addition to the direct current, high frequency currents were induced in the same conductor, the resistance to the d.c. changed so as to shift the curve towards lower temperatures (*A'B'*). The switching on and off of the high frequency generator changed the resistance reversibly from the point *A* to *A'*, from *B* to *B'*, and so on. The position of the displaced curve was found to depend upon the ratio of the magnitudes of the high frequency to the direct current in the specimen. When this ratio was decreased by decrease of the induced high frequency currents or by increase of the direct current, curves were obtained lying between those shown in the graph.

(2) (Fig. 1 (b)). Curve I represents the relation of the high frequency resistance and the temperature. When, in addition to the alternating current, direct current was applied to the specimen, curve II resulted.

When both currents were flowing, the critical point for the high frequency resistance was the same as the critical point for the direct current resistance; the position of this common critical point on the temperature scale is determined by the ratio of the magnitude of the direct to that of the alternating current. Thus, when the superconducting state had been established at this common critical temperature, resistance was offered neither to direct nor to alternating currents.

Two effects have therefore been established, the depression of the critical point for the direct current resistance by the application of high frequency currents, and the raising of the critical point for the high frequency resistance in the presence of a direct current. Full details of the experiments are in preparation for publication elsewhere.

These experiments confirm the reality of the frequency disturbance of the superconducting point found in our early experiments, and it follows that any theory of the nature of superconductivity that may be advanced must include an explanation of this new phenomenon.

J. C. McLENNAN.
A. C. BURTON.
J. O. WILHELM.
A. PITT.

McLennan Laboratory,
Department of Physics,
University of Toronto, June 29.

[1] *Proc. Roy. Soc.*, A, 136, 52; 1932.

Inter-Diffusion of Metals

WE have recently applied high precision X-ray analysis to the study of the inter-diffusion of two metals in the solid state. Although the experimental work so far has been confined to mixtures of copper and zinc particles (heated *in vacuo*), enough data have been obtained to show that this new method has distinct advantages over the methods hitherto employed, and that it admits of wide application. Its two principal features are: (a) the direct measurement of a fundamental quantity, namely, lattice parameter (or mean atomic volume), while, in other methods employed to study this phenomenon, mean values of such quantities as chemical composition, width of zones, electric resistance, thermoelectric effect have been determined; and (b) each phase present at any time gives its own X-ray reflection lines independently, from which its composition can be readily found from standard composition-parameter curves.

In Fig. 1, a series of prints from portions of X-ray

photographs is reproduced, in which the trend of inter-diffusion in a 70 per cent copper-zinc mixture, at 450° C., can be followed, for diffusing times varying from 10 minutes to 140 hours. The reflection lines from the different phases are clearly shown. During the early stages in the production of a phase, lattice distortion usually causes the reflection lines to be broad and unresolved; but while the accuracy attainable in the mean parameter measurements is thereby somewhat impaired, it is considered that the composition derived from such measurements is still accurate enough for the present purposes. It may be added

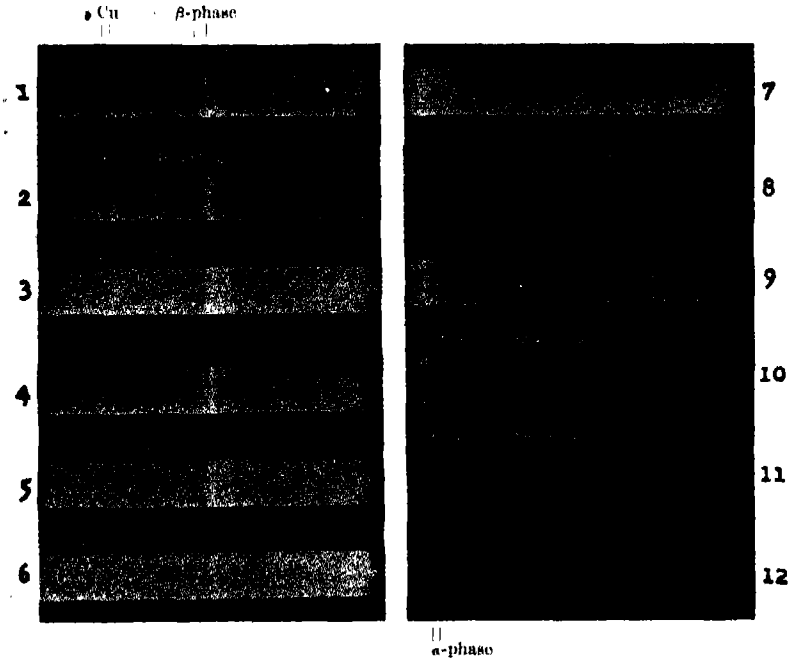


FIG. 1.—X-RAY PHOTOGRAPHS OF MIXTURES OF FILINGS OF COPPER AND ZINC CONTAINING 70 PER CENT COPPER HEATED AT 450° C. FOR DIFFERENT TIMES

Photo. No.	Time of Diffusion.	Parameter (in A.).			Photo. No.	Time of Diffusion.	Parameter (in A.).		
		Copper.	β-phase.	α-phase.			Copper.	β-phase.	α-phase.
1	10 min.	3·6079	2·947	—	7	8 hr.	—	2·943	3·688
2	¼ hr.	3·6079	2·945$_6$	—	8	12½ hr.	—	—	3·686
3	½ hr.	3·6079	2·944$_6$	—	9	18 hr.	—	—	3·685
4	1 hr.	3·6079	2·943$_8$	—	10	45 hr.	—	—	3·680$_1$
5	2 hr.	3·6079	2·943$_7$	—	11	70 hr.	—	—	3·679$_7$
6	4 hr.	—	2·943$_3$	3·69$_8$	12	140 hr.	—	—	3·674$_3$

Parameter of 70 per cent Cu-Zn Alloy = 3·674$_1$

that the precision measurements are capable of giving parameter values to at least 1 in 4000, with good reflection lines on the most unfavourable positions on the film.

From a study of various series of data, similar to that in Fig. 1, there appears no doubt that the inter-diffusion of copper and zinc is entirely controlled by the thermal equilibrium diagram, the rate of diffusion in the various phases being different. Consequently, while our investigations had initially in view the study of the general laws of inter-diffusion in the solid state, it was realised that the copper-zinc system was too complex to attain the object satisfactorily.

The data obtained by using particles of different graded sizes showed, however, that the rate of diffusion at a given temperature was independent of particle size. Also, the fundamental law of inter-diffusion appears, and is put forward tentatively here, to be of the form $c_0 - c = \Sigma K e^{-mt}$, where c is the composition at time (t), c_0 the final composition, and K and m are constants depending upon the temperature at which inter-diffusion takes place, each phase present having a different set of constants. This relation is different from Weiss's law,[1] $dc/dt = 1/t$, which Ageew and Vher claim to have demonstrated experimentally.[2]

We hope to publish shortly a detailed account of this new development and the data obtained. At present, an investigation into the inter-diffusion of copper and nickel is being carried out by the method, as we anticipate that this latter system, owing to its simple solid solution constitution at all compositions, will eliminate certain complications and yield more definite and conclusive experimental data as regards the fundamental law of the inter-diffusion of metals in the solid state.

E. A. OWEN.
L. PICKUP.
University College of North Wales,
Bangor, June 25.

[1] *Ann. Chimie*, **19**, 201; 1923: **20**, 131; 1923.
[2] *J. Inst. Met.*, **44**, No. 2, 1930.

'Protective' Adaptations of Animals

I AM sure that B. P. U. would not willingly misrepresent the opinions of those with whom he disagrees, yet he has done so when he refers to the existence of a common belief "that anything found in a bird's stomach would be in an unrecognisable state"[1]. I do not know of any naturalist who holds this opinion. B. P. U. has apparently extended into this sweeping statement the conclusion that the remains of butterflies eaten by birds soon become unrecognisable as Rhopalocera, except with the aid of the microscope. The history of this conclusion is interesting. In W. L. McAtee's earlier paper, "The Experimental Method of Testing the Efficiency of Warning and Cryptic Coloration in Protecting Animals from their Enemies",[2] the following statement appears:

"Practically the only large body of authentic information on the natural food habits of birds is contained in the records of the United States Biological Survey. They comprise detailed identifications of the contents of more than 48,000 bird stomachs, representing all families of birds and collected in hundreds of localities in the United States at all seasons. The United States has a goodly representation of butterflies, yet only five of these 48,000 stomachs contained remains of Rhopalocera."

About the time when this paper was published, certain distinguished naturalists in Great Britain expressed the concurrent opinion that birds rarely attacked butterflies, and some of them stated that they had never, in all their experience, witnessed such an attack. Accordingly, those other naturalists who, on various grounds, had come to the conclusion that birds are the chief selective agents in the evolution and maintenance of butterfly mimicry, set to work to test the value of this negative evidence as well as the trustworthiness of McAtee's "authentic information". The result has been, in the first place, the accumulation

of a great body of direct and indirect evidence, and in the second, the proof, by C. F. M. Swynnerton and W. A. Lamborn, that butterflies, after being eaten by birds, are soon rendered unrecognisable save by the use of the microscope. The further result has followed that McAtee, although he attempts no explanation or defence of his earlier figures, now records the remains of butterflies (24 in the larval, 2 in the pupal state), in 113 out of 80,000 stomachs. To search with the compound microscope for butterfly wing-scales scattered through the contents of 80,000 avian digestive tracts would be a serious business, and if it had been accomplished I venture to believe that far more positive results would have been obtained.

Apart from butterflies and moths and some other specially delicate forms, it is well known, and, so far as I am aware, has never been disputed, that the group and sometimes even the species of insect is readily recognisable when present in a bird's stomach.

It would be inconvenient, within the scope of a letter, to make any further comment on McAtee's two papers and on B. P. U.'s other conclusions founded upon the second.[3] A detailed reply, now in course of preparation, will, it is hoped, appear in the near future.

EDWARD B. POULTON.

Oxford University Museum,
July 13.

[1] NATURE, July 9, 1932, p. 66.
[2] *Proc. Acad. Nat. Sci.*, Philadelphia, June 1912, p. 281.
[3] Smithsonian Miscellaneous Collections, vol. 85, No. 7, p. 201. Washington, 1932.

B. P. U.'s article on "The Value of 'Protective' Adaptations of Animals" in NATURE of July 9 demands some comment. The issue can only be finally settled by *ad hoc* experimentation; there has already been a certain amount of this, and on the whole it has given evidence of discriminative rejection of certain types.

That, however, can be dealt with by those more familiar with the details of the work than I am. I would here only like to point out what I believe to be a fundamental fallacy in the conclusions summarised by B. P. U.

The arguments put forward appear to be threefold:

(1) The number of insects found in birds' stomachs is proportionate to their numbers in Nature. The proportionality, however, is admitted to be rough only.

(2) Even groups which are usually said to be specially protected are eaten. "Some birds eat ants in very large numbers."

(3) Some organisms which are known to be poisonous are freely eaten, though this causes the death of their captors.

With regard to the first point, it is, I think, relevant to point out that if an inquiry were held we should doubtless discover that the number of ships of different type which are wrecked are *roughly* in proportion to their numbers, whether they are equipped with Diesel or steam engines, with this or that type of steering gear, this or that type of compass. Again, the number of war vessels of different types sunk by enemy gunfire during the War would doubtless prove to be roughly proportional to their numbers, irrespective of the thickness of their armour-plating. So long as the proportionality is rough, such facts have no relevance whatever to the question of whether the armour-plating, the type of compass, etc., have functional value for navigation. Even if the proportionality were exact, it would have little significance. All ships have to be 'adapted' to navigation in a number of ways if they are to survive the dangers of the sea at all: those that are 'worse adapted' in regard, for example, to compass or power, deliberately do not take such risks as others, but stick to coastwise traffic, and do not put out when 'better adapted' boats would not hesitate: their 'adaptation' is in their habits.

So with organisms. They all have to be adapted in a thousand ways if the species is to persist. With regard to avoiding their enemies, some do so by stressing protective coloration, others by protective and retiring habits, others by high fecundity, others by distastefulness, others by toughness, others by speed, etc. The avoidance of enemies is never perfect; but this does not in the least invalidate the fact that to achieve survival numerous adaptations have been necessary. We should also remember that a certain number of protectively coloured animals will of necessity be discovered, a certain number of warningly coloured ones eaten. The absolute number, and also the proportion, will increase with (*a*) the abundance of the species itself, (*b*) the hunger of the enemy species. This mechanism helps to produce the rough proportionality between abundance and number eaten; but it tells us nothing as to whether the total abundance would not have been quite different if the colour were not adaptive.

One has only to imagine an organism which was conspicuous in colour and in habits, sluggish, palatable, juicy and soft, and with a low fecundity. How long would the species survive? I take it, about as long as a type of ocean-going ship with no compass or steering gear.

A species is only adapted *to survive*, not to become immune from all enemies (which would, in any case, lead to destruction through over-multiplication); and each adaptation is relevant only in its particular way.

As regards point (2), it is a well-known fact that adaptation for protection is frequently met by counter-adaptation for attack. The fact that "some birds" (B. P. U.'s own words) eat ants freely does not imply that ants are not rejected, relatively or entirely, by most birds. To deny this is like denying that submarines are particularly immune from detection by most ships, on the ground that by special methods they can often be located and destroyed by depth charges.

Point (3) may or may not mean anything. Without precise investigation directed especially to the ecology of the species, it is impossible to say whether or not the poison or the distastefulness may not actually confer protection against other organisms than those which do eat them. This is really a variant of the answer to point (2). Some plants are in general poisonous, and appear to be therefore immune from being used as food by most insects; but they are eaten by insects which possess a special immunity (cf. certain Papilios).

In general, the fallacy is that of forgetting that no species of organism could exist which was not a bundle of adaptations, but that each particular adaptation is partial and relative.

JULIAN S. HUXLEY.

King's College, London.

Degenerative Mutations

IN Mrs. Sexton's important paper [1] on "Degeneration and Loss of the Eye in the Amphipod *Gammarus chevreuxi*" she makes one remark which, in its suggestion of theoretical controversy, is in striking contrast with the mass of details of observation, and minute records of genetical facts, of which the rest of the paper consists. The sentence to which I refer is: "In view of all that has been written on the origin of the blind fauna, it is a significant fact that blind animals could be produced within the limits of a single species in such a short time and in so few generations".

This means, apparently, that the blindness of cave

animals has not been gradually evolved under the influence of darkness, but is the result of degenerative mutations of the same kind as those described in Mrs. Sexton's paper. She describes a series of retrogressive mutations, red-eye in 1912, albino-eye in 1915, 'spotted', and one-eye and no-eye in 1920. The absence of one or both eyes occurred among the descendants of a single mating in which the three earlier mutations were combined. In the latest degenerations, the shape of the head was frequently altered; in some cases the first antennæ were absent, the shape of the brain was abnormal, and finally there was a marked degeneration in the reproductive organs, many individuals being sterile and others intersexual. No such progressive degeneration in many directions has been shown to occur in the blind Crustacea or blind animals of other classes in the cave fauna, or in *Gammarus chevreuxi* itself in the wild state.

I would suggest that Mrs. Sexton's stock of *G. chevreuxi* offers a much closer and more obvious analogy to Japanese goldfish in their monstrous abnormalities than to blind cave animals. In both the former cases, the degenerative mutations occur in animals kept in close confinement under abnormal and unhealthy conditions, and it seems reasonable to conclude that such conditions are the real cause of the so-called mutations. Vigorous and normal development depends on normal conditions. The normal genes do not live a charmed and invulnerable existence; the evidence suggests that they are altered and enfeebled by confinement, by impurities and deficiencies in the surrounding air or water and in the diet, by want of exercise, with the result that in the course of generations their power to determine normal and vigorous development is enfeebled and all kinds of deficiencies and abnormalities appear and increase until the strain dies out. As Mrs. Sexton herself says, "the farther removed from the normal an animal is, the lower its viability".

Thus it seems to me that the significant fact is, not that blindness may be produced without the influence of darkness and that therefore the blindness of cave animals has not been due to the absence of light, but that degenerative and hereditary mutations are caused by the abnormal conditions involved in keeping animals confined in small vessels inside a laboratory for a long series of generations, and that further degeneration is produced by combining such mutations by interbreeding.

J. T. CUNNINGHAM.

35 Wavendon Avenue,
London, W.4, July 2.

[1] *J. Mar. Biol. Assoc.*, May 1932.

Cytological Differences between Closely Allied Species

IN 1931 [1] I described important differences between the watery, neutral, red-staining vacuoles of the eggs of *Rana tigrina* and *Rana cyanophlyctis*. For details references may be made to the original paper, but the most important difference is in the size of the vacuoles, those of *tigrina* measuring as much as 0·02 mm. in advanced oocytes, whereas those of *cyanophlyctis* are very much smaller.

In the course of certain experiments carried out last summer on the eggs of a large number of animals with Sudan III. and Scharlach R. to determine the exact time when the lipoidal Golgi elements become fatty, it was discovered in *R. tigrina* that the fatty yolk, which had been reported by me in 1931 to be absent in the biggest egg (1·08 mm.) then studied, actually puts in its appearance when the egg measures 1·2 mm. From this stage up to 1·5 mm. (the biggest egg I have ever examined in this species) the fats stain deeply with the above dyes, but no red granules appear in younger oocytes. In *R. cyanophlyctis*, on the other hand, the Golgi elements become fatty when the oocyte measures a little more than 0·5 mm.

In 1931 I sounded a note of caution as to "how discordant results can be arrived at by two workers investigating two species of the same genus". I added that "if I had not first studied the big vacuoles of *tigrina* I might have perhaps failed to notice those of the other species. I imagine that the British and European frogs in which no vacuoles have been described are like *cyanophlyctis*."

That is exactly what has actually happened. Prof. Saguchi,[2] working on the eggs of *Rana nigromaculata*, confirms most of my conclusions, but finds that there is no vacuole and that fat appears when the egg measures 0·3 mm.

I would like to recommend the eggs of *R. tigrina* to all teachers in India running cytology courses for demonstrating the Golgi elements, the mitochondria, and the vacuolar system in fresh oocytes without the aid of any vital dye. The most favourable stage for this is when the oocyte measures about 0·45 mm. In the highly advanced oocytes there is a well-developed cortex containing the vacuoles. This can be easily separated for demonstration.

VISHWA NATH.

Department of Zoology,
Government College, Lahore, June 9.

[1] *Zeit. Zellf.*, 1931.
[2] "Zytologische Studien", 1932.

The Inheritance of Acquired Characters

PROFS. MACBRIDE and Harrison have devoted some space to refuting a number of statements which I have never made.[1] "He suggested in his discourse that Harrison's strain of sawflies had become contaminated with a strain adapted to the new willow", writes Prof. MacBride. As the discourse is printed in NATURE of June 4 and 11, it is easy to verify the fact that I made no such suggestion. Nor have I ever made any of the criticisms found in Prof. Harrison's last paragraph. I was, however, quite aware of the facts of which he accuses me of lack of knowledge. They would doubtless have been relevant had I made the statement attributed to me above.

Perhaps the somewhat imaginative manner in which Prof. MacBride has dealt with my discourse will make readers of NATURE cautious in accepting his interpretations of the work of Dürken, Metalnikoff, and others.

J. B. S. HALDANE.

Roebuck House, Cambridge.

[1] NATURE, 130, 128, July 23, 1932.

A Reinterpretation of Relativity

THE theory of relativity is an undeniable achievement in physics and is a logical development of the theory of measurement; but it does not have the significance for the universe which is usually ascribed to it. Real time is *not* fused with space, and *absolute simultaneity does have a definite and definable meaning.*

Physics as a science is concerned with measuring and dating and so getting numerical laws. All this gives knowledge about the external world. But it would be a mistake to project this measurational knowledge into Nature without interpretation. The rejection of absolute simultaneity as meaningless has encouraged most relativists to do this.

My analyses have led me to make a distinction between *chronological time* and *real time*. Chronological time is an affair of dating and measuring in terms of some standard motion. Real time is the fact of change, or eventness. I hold that absolute simultaneity has meaning for real time, while operational simultaneity, which is the kind that relativity stresses,

is bound up with light-signalling. When two bodies are moving with respect to one another, their operational simultaneities are not identical. It follows that length (space) and *t* (chronological time) as numerical quantities always require a reference to the frame from which the measurements are made. It is for this reason that physicists speak of space-time. They mean that length and *t* as quantities are not separable.

I have no criticism to pass upon this so long as measurement is not confused with what is being measured. Measurement gives knowledge about Nature. The philosopher—and I hope the physicist also—needs likewise to think clearly about the structure of Nature. It is here that the question of the real nature of time appears. Is the Astronomer Royal's time—to use Eddington's expression—as basic as supposed ? I take it that physicists like Jeans, Eddington, and Millikan are aware of this problem.

It is my thesis that real time is simply the fact of change or eventness in the universe and is always local. There is no change which runs instantaneously across the universe. The unity of the universe is spatial rather than temporal, and is of the nature of substantial coexistence and continuity. Nevertheless, it is correct to speak of a cosmic time if we simply mean the *class of events* coactual with any given event. In real time, simultaneity is the fact of co-occurrence and is not a kind of cosmic temporal relation. It is in this sense only that the universe moves abreast. Past events are those which have perished and are no longer actual. Future events are those which are not yet actual. *Simultaneous events are just the class of actual events*. This is what the philosopher and the physicist must mean by absolute simultaneity. But the physicist has a job of an empirical sort which the philosopher does not have: that of dating and measuring. The job of the philosopher is essentially that of analysis of categories. For him, real time involves the order of succession and the class of actual events in the universe. He is as much opposed as the modern physicist is to Newtonian conceptions of time.

It follows that the fusion of space and time must not be taken as valid for anything but chronological knowledge about Nature. In Nature itself, only the actual exists. I am also led to believe in determinate size apart from measurement. Quantities are cases of knowledge about and are relative to a frame; but not so the intrinsic properties of things. I am also led to believe in gravitational forces and to distinguish them from the kinematic description in terms of space-time. It follows also that relational movements have meaning as well as relative motion. Relational movements are changes of neighbourhood, while relative motion is an affair of epistemic reference, which presupposes actual movement.

Finally, so far as I can see, cosmic time has no arrow of an entropic sort. It is merely the fact of dispersed change in a substantial, extended world. I expect to find that Millikan, Lewis, and Bridgman will turn out to be right in their criticism of the application of entropy to the universe.

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The Absorption Spectrum of Hexuronic Acid

As part of a systematic study [1] of Prof. Szent-Györgyi's 'hexuronic acid' we have investigated quantitatively the absorption spectra of hexuronic acid, glycuronic acid, galacturonic acid, tetramethyl γ-fructose, and other carbohydrate derivatives. In view of the fact that hexuronic acid has been identified with vitamin C,[2] we have paid special attention to the possibility of contamination by small traces of impurity. We find that the single broad band at about 263 mμ reported qualitatively by F. P. Bowden and C. P. Snow [3] is found in equal intensity with the sample of hexuronic acid supplied by Prof. Szent-Györgyi and with rigorously purified material. It appears, therefore, that this band is definitely associated with hexuronic acid. The nature of the band in methyl alcohol (*c.* 0·002 per cent) is indicated by the accompanying table:

Mol. Extinction Coefficient (ε).	Wave-length (mμ).
1000	295
2000	220, 290
3000	228, 285
4000	235, 280
5000	241, 278
6000	245, 272
7000	254, 268
7500	263

Marked deviations from Beer's law were observed, the solutions becoming relatively less transparent on dilution. For example, at 280 mμ the molecular extinction coefficient has the values 800, 2000, and 4400 for solutions of concentration 0·02, 0·005, and 0·002 per cent respectively. Dilute methyl alcoholic solutions of hexuronic acid are unstable and show, when kept, a gradual diminution in the intensity of the band.

In water a single broad band is displayed at 260 mμ. The value of ε is about 7000 for freshly prepared solutions (*c.* 0·002 per cent), but in this solvent a rapid diminution in the intensity takes place, ε falling to 4000 within three hours.

The absorption of hexuronic acid resembles that of many ketonic substances, but differs completely from that shown by aldose or ketose sugars of the pyranose type,[4] which show no absorption bands. We have now proved that a typical keto-furanose sugar (tetramethyl γ-fructose) shows no selective absorption. Similar results were obtained with glycuronic acid and with galacturonic acid. All these substances are highly transparent in water and display weak continuous absorption, with ε in each case less than 5 at 260 mμ.

The tentative formula for 'hexuronic acid' previously suggested [5] envisages a possible keto-furanose sugar structure with the carboxyl group in position 6. In view of the above results, it seems improbable that such a structure would account for the absorption band observed with hexuronic acid, and some rearrangement of the formula may therefore be necessary. Experiments to decide this are now well advanced.

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E. L. HIRST.

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July 1.

[1] E. L. Hirst and R. J. W. Reynolds, NATURE, April 16, 1932, p. 576.
[2] J. L. Svirbely and A. Szent-Györgyi, *ibid.*, p. 576.
[3] NATURE, May 14, p. 720.
[4] L. Kwiecinski and L. Marchlewski, *Bull. Acad. Polonaise*, 1927, 379.
[5] NATURE, April 16, p. 576.

Crystalline Structure of Hexuronic Acid

FROM a purified specimen of 'hexuronic acid' (identified by Szent-Gyorgyi with vitamin C) available in this laboratory I have been able to obtain sufficiently good crystals to carry out an X-ray examination by the single-crystal rotation method. The substance is monoclinic sphenoidal, with $a = 17·71$, $b = 6·32$, $c = 6·38$ A., and $\beta = 102\frac{1}{2}°$, while the space-group is C_2^2 ($P2_1$), since the only true halving is

(0k0) absent when k is odd. The density of the crystals was determined by the flotation method to be 1·65 gm./c.c., so that there are four molecules of $C_6H_8O_6$ in the unit cell. Since C_2^2 has only twofold symmetry, a pair of molecules must be associated to form the asymmetric crystal-unit. (This does not necessarily imply polymerisation.)

On examination microscopically, the crystals are found to be tabular on (100), usually almost square, and exhibiting pronounced cleavage parallel to (010). The birefringence is very high and negative, the refractive indices being $\alpha = 1{\cdot}464$, $\beta = 1{\cdot}68$ (approx.), and $\gamma > 1{\cdot}70$, with α parallel to the b-axis. These results indicate that the molecules are nearly flat and lie in the (010) plane. The birefringence (>0·24) is much higher than any so far observed among the carbohydrates or their derivatives, although that of γ-mannonolactone is about half this amount. This suggests that the hexuronic acid molecule has a ring structure with fewer groups projecting out of the plane of the ring than a normal carbohydrate, and contains double-bonds, possibly in carbonyl groups. The X-ray results are in agreement with these conclusions; the thickness of the molecule must be ½ b, that is, 3·16 A., which is considerably less than that of any carbohydrate so far examined, indicating a flatter molecule, while the regular falling off of the intensities of the {020} reflections also requires a fairly flat molecule parallel to (010).

A very interesting feature of the X-ray results is that unless very long exposures are given, the photographs show no reflections from ($hk0$) planes for which h is odd. This indicates an almost perfect glide-plane of symmetry perpendicular to the c-axis, and therefore a pseudo-plane of symmetry in the molecule itself, at right angles to the plane of the ring. Since carbon and oxygen have nearly the same volumes and scattering powers, such an arrangement can occur without destroying the optical asymmetry of the molecule.

Optical examination and X-ray powder photographs show that the purified hexuronic acid is identical with the crystalline portion of the original substance obtained from Prof. Szent-Gyorgyi. (The amount of impurity in the latter is apparently quite small.)

A more detailed account of this work will be offered for publication in due course. I am indebted to Dr. E. L. Hirst for supplying the purified material and for numerous helpful discussions.

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July 18.

Anaerobic Activation of Glycolysis in Tumour Tissue

ROSENTHAL[1] has shown that when the anaerobic conversion of fructose to lactic acid by the Jensen rat sarcoma is studied by Warburg's method, a spontaneous increase in the rate of acid production ($Q_M^{N_2}$), which he ascribes to the anaerobic formation of an activator, occurs about forty minutes after the manometric vessels are put into the thermostat at 38° C. We have been able to show that this spontaneous increase may also be demonstrated when glucose is the substrate, although here the pre-activation period is shorter; and we find that with both sugars the pre-activation period is abolished when sodium pyruvate is present in 10^{-3} M concentration.

Sodium pyruvate was stated by Mendel, Bauch, and Strelitz[2] to increase the anaerobic fermentation of glucose by normal body tissues. We find that when sodium pyruvate is added, by tipping from a side bulb, to Jensen rat sarcoma in fructose-containing Ringer solution during the period preceding the spontaneous increase of anaerobic fermentation, $Q_M^{N_2}$ rapidly rises and remains constant at approximately the value which would eventually have been reached by the spontaneous activation; whereas after this latter has occurred, addition of sodium pyruvate has no effect (Fig. 1 (i)). Further, the Mill Hill fowl tumour, although attacking fructose with about the same vigour as the Jensen sarcoma, does not show this spontaneous rise in lactic acid formation, and in this case sodium pyruvate shows no action.

A spontaneous increase of rate of lactic acid formation from glucose is not ordinarily observed with the Jensen rat sarcoma. We find, however, that if the tumour slices be suspended anaerobically at 38° C. for

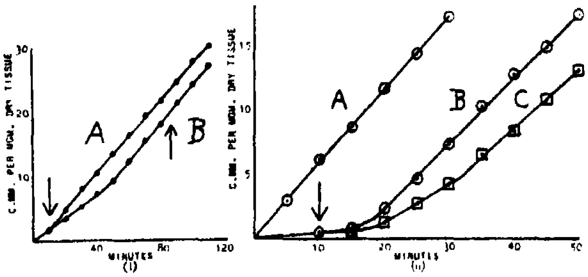

FIG. 1.—Lactic acid production by Jensen rat sarcoma, (i) in 0·2 per cent fructose solution; A, pyruvate added at 10 min.; B, pyruvate added at 85 min. (ii) A, glucose present from start; B, glucose and pyruvate added at 10 min.; C, glucose only added at 10 min.

20 minutes in sugar-free Ringer solution in the manometric vessels and glucose be then added from the side bulb, a preliminary de-activation results which allows a spontaneous re-activation to be observed. For after glucose addition, $Q_M^{N_2}$ does not immediately rise to its final value, but stays at a steady intermediate value for about 15 minutes and then rises rapidly to its steady final level. The presence of 10^{-3} M sodium pyruvate in the solution, or its addition together with the glucose, abolishes this preliminary period, $Q_M^{N_2}$ rising rapidly to the final value very soon after the glucose is added. Addition of 10^{-3} M pyruvate to the solution when glucose is present from the start causes no increase in the anaerobic lactic acid formation (Fig. 1 (ii)).

It thus seems that sodium pyruvate may replace the anaerobic activator in partially activated tissues, but has no effect when the activation is complete. The detailed results will be published in due course.

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[1] Z. Krebsforschung, 32, 220; 1930.
[2] Klin. Woch., 10, 118; 1931.

Anomalous Adsorption on Active Charcoal

AT the recent discussion of the Faraday Society on the "Adsorption of Gases on Solids", Prof. A. J. Allmand and his co-workers[1] presented a summary of their investigations on the discontinuities they have found in adsorption isotherms for gaseous adsorptions.

They also referred to unpublished evidence, obtained by Chaplin, for the discontinuous adsorption of phenol from aqueous solutions on an active technical charcoal. This statement apparently refers to an investigation the details of which have now been published.[2] Of the three isothermals obtained, Chaplin prefers to place reliance upon the third one, the other two being inaccurate for the reasons discussed by the author himself. Chaplin has drawn an isothermal curve through the experimental points which exhibits marked discontinuities. It appears, however, that the curve has been drawn in an arbitrary manner, and a smooth adsorption isotherm can be obtained within the experimental error, only one point being markedly off the curve.

If the existence of discontinuities could be clearly substantiated, then this must lead to a reconsideration of current adsorption theories. With the hope of throwing some light on the subject, it was decided to

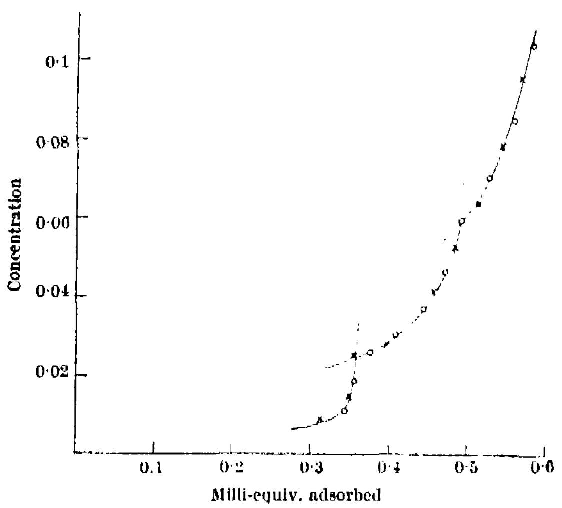

FIG. 1.—Curve showing the quantity of phenol adsorbed (milli-equivalents) from 25 c.c. solution per gm. of charcoal as a function of the concentration (milli-equivalents in 25 c.c.).

repeat Chaplin's work, employing another and probably more accurate method of analysis. The adsorbent used was an oxygen (atmospheric) activated ash-free sugar charcoal which has been employed previously,[3] and the concentrations of the phenolic solutions were determined with a Zeiss interferometer; the phenol used had been purified by repeated fractional distillation. A very unusual adsorption isotherm (25°) was obtained (Fig. 1) with two series of measurements. No discontinuities of the type postulated by Allmand and his co-workers have been found, but the isotherm is composed of three distinct curves, each of which appears to extrapolate back to the origin.

Several interesting possibilities present themselves, but it is desirable to investigate the phenomena more intensively before a detailed discussion is entered upon. It is, however, worth pointing out that each of the curves, when treated independently, conforms to the adsorption theory of Langmuir.

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June 30.

[1] *Trans. Far. Soc.*, **28**, 218; 1932.
[2] *J. Phys. Chem.*, **36**, 909; 1932.
[3] *J. Chem. Soc.*, 613; 1932.

Effect of Carbon Monoxide on the Biological Reduction of Nitrate

THE reduction of nitrate is accomplished by cells of very diverse types—plant, animal, and bacterial. A thermolabile catalyst controls the activation of nitrate, though cases are known where apparently nitrate may be reduced by biological means without the intervention of a specific catalyst.[1] The distribution of the nitrate oxidase, as the catalyst may be conveniently termed, seems to be very haphazard; it occurs in the livers of most animals, but nitrate reduction in muscle is confined to the rat and guinea-pig. Among the bacteria, it is absent from obligate anaerobes and aerobes, but it occurs in most faculative anaerobes. With these organisms nitrate serves as an oxidising source and will enable anaerobic growth to occur in its presence.[2] The nitrate oxidase is present in *B. coli*, the ability of which to reduce nitrate to nitrite has been made a test of its presence in biological fluids. The activity of the enzyme is greatly inhibited by traces of hydrogen cyanide,[3] but if a suspension of *B. coli* which has been exposed to quite a high concentration of hydrogen cyanide is well washed with saline the organism regains its ability to activate nitrate.[4] The effect of cyanide on nitrate oxidase is thus reversible.

Preliminary experiments, carried out recently in this laboratory, now indicate that carbon monoxide has a small but definite inhibitory action on the reduction of nitrate by *B. coli*, the inhibition apparently being greater the smaller the quantity of nitrate present.

Nitrate reduction by *B. coli* in presence of a suitable donator is not only inhibited by carbon monoxide but also by oxygen, the effect with oxygen being far greater than with carbon monoxide. From the facts available so far, it would seem that nitrate, carbon monoxide, and oxygen all compete for the nitrate oxidase, and the inference would be that the enzyme belongs to the iron-containing class of molecule which has been described as responsible for the activity of peroxidase, catalase, and the indophenol oxidase. Further investigation is necessary to decide whether this is the case.

There is some evidence that the chlorate oxidase of *B. coli* is inhibited also by oxygen and carbon monoxide.

Details of this work will be published in due course.

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[1] Bernheim and Dixon, *Biochem. J.*, **22**, 125; 1928.
[2] Quastel, Stephenson, and Whetham, *Biochem. J.*, **19**, 304; 1925.
[3] Loffler and Rigler, *Biochem. Z.*, **173**, 449; 1926.
[4] Quastel and Wooldridge, *Biochem. J.*, **21**, 1234; 1927.

Zoological Nomenclature

IN accordance with prescribed routine, the undersigned invites the attention of zoologists to the fact that application has been made to the International Commission on Zoological Nomenclature to suspend the Rules and to place in the Official List of generic names:

Lepidocyclina Gümbel, 1868, type (1898) *Nummulites mantelli*; objective synonym *Cyclosiphon* Ehrenberg, 1856, type *N. mantelli*; *Lytoceras* Suess, 1865, genotype *Ammonites fimbriatus* Sowerby; and *Ophiceras* Griesbach, 1880, genotype *O. tibeticum* Griesbach.

These cases will be held open until about July 1, 1933, to enable zoologists to submit to the Commission their opinions, for or against the proposition.

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Secretary.

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Research Items

English Folk-Dances.—Miss Maud Karpeles has published in *Folk-Lore*, vol. 43, No. 2, a study of the survival and revival of folk-dances, in which she reviews the principal types of folk-dance with special reference to the study of their meaning as a borderline province for the folk-dancer and the folk-lorist. The sword dance, which has survived in Yorkshire, Northumberland, and Durham, is danced by five men, or in Yorkshire by six or eight men, usually accompanied by additional characters, the 'fool', the 'king', 'queen', and 'Bessie'. The sword in Yorkshire has a wooden handle at one end but in Durham is a piece of flexible steel with a handle at each end. In the climax of the dance the swords are woven into a 'lock', 'nut', 'rose', or 'glass', and one character suffers a mimic decapitation. There are several features in the dance as it was sometimes performed which point to a play from which it has become detached. Fragments of the play have been noted and, like the mummer's play, it is evidently of a ritual character, a fertility rite of which an animal sacrifice once formed part. The other main type of spectacular dance is the morris, for the name of which the best derivation up to the present seems to be 'Moorish', as referring to the blackened faces of the dancers in earlier times, of which traces survive in a smudge of black worn by some dancers in recent times. The morris may be an offshoot of the sword dance. There is, however, no trace of the sacrificial victim, though there are signs of a sacrificial or sacramental rite which are not embodied in the dance itself. It may be a processional lustration dance in which the stationary dance at certain spots has been elaborated at the expense of the processional.

Ritual Use of Fire in Queensland.—Mr. Donald F. Thomson describes in *Man* for July some ritual uses of fire among the Koka Dai'-yuri and other tribes of the lower Edward River, Gulf of Carpentaria, among whom social life differs little except in detail. As a centre of family life, fire establishes or affirms a bond of solidarity between individuals or within the group. Each family has its own fire, and family life centres around it. Of the two camps consisting of the single men and single women respectively, each has its own fire; and however intimate may be relations, no individual from outside the family joins the family fire; he has his own fire, though it may be only a few yards away. In the Ompela tribe, the simple act of sharing a fire in the presence of the camp constitutes the marriage ceremony. At the critical stages of life when an individual is cut off from participation in normal social activities, he or she camps at a fire apart from others. Fire is presented ceremonially to visitors. On approaching the camp they sit down outside until a 'big' man unarmed has sat down opposite them and then after a period has ordered a small piece of smouldering fire to be brought from the camp and presented to one of them. They then enter the camp. Fire is also used ceremonially in connexion with mourning and burial rites. After the body or bones of the deceased have accompanied the mourners for a period of two or three years, and the time has come to end the mourning, the body is laid in the dry bed of a river and a fire lighted at its head, while food and a small trough of water stand by. After a dance by the women and laments from the men, the mourning paint is washed off and the fire extinguished with the water from the trough, as all lament loudly.

Inheritance of Alkaptonuria.—So early as 1902, it was suggested that alkaptonuria is determined by a recessive Mendelian factor. The condition is apparently due to the absence of an enzyme which catalyses the destruction of homogentisic acid in the human body, with the result that this substance is excreted in the urine. In an analysis of all the accumulated evidence, Messrs. Hogben, Worrall, and Zieve (*Proc. Roy. Soc. Edin.*, **52**, Part III., No. 13) have summarised all the known pedigrees and confirm the above conclusions. The condition is very rare, being estimated to occur less frequently than 1 in 1,000,000 of the population. While it is recessive in a large majority of pedigrees, it occurs as a dominant in certain families, and particularly in one pedigree of four generations. One case of its probable origin by mutation is also recorded. The total number of recorded cases is now 151, of which 100 are males and 46 females. There is at present no satisfactory explanation of the excess of males, but the results are otherwise in accord with Mendelian expectation.

Parasitism and Nutrition in Sheep.—Field trials carried out in 1931 by Dr. I. Clunies Ross and N. P. Graham, of the Division of Animal Health of New South Wales, revealed the predominant influence of good nutrition over parasitism in sheep (*J. Council Sci. Ind. Res.*, vol. 5, 1932, p. 31). Lambs belonging to a lot known to be heavily infected with various internal parasites, the more important of which were the stomach worms, *Hæmonchus contortus*, *Ostertagia circumcincta*, and intestinal worms belonging to the genera *Trichostrongylus* and *Nematodirus*, were divided into five lots and run on different qualities of pasture. All the sheep were weighed at monthly intervals, and fæces from five sheep in each group were cultured each month to determine the type and degree of parasitism. The trial ran from March 26 to Oct. 23–24, when the sheep were finally weighed and shorn. It was found that the increased risk of parasitism due to heavy stocking on improved pasture was more than offset by the improved condition of the sheep run on such pastures. The difference between the produce of un-top-dressed natural pasture and of improved pasture without rotation (at 2½ sheep an acre) amounted to 18 lb. 5 oz. of wool and 83 lb. 7 oz. of live weight per acre, and still further gains were recorded where a monthly rotation was in force. Medicinal treatment against internal parasites produced no demonstrable effects in treated sheep in comparison with untreated sheep under the same conditions on improved pasture. Indeed, at the end of the trial, practically all worm infestation appeared to have been thrown off by sheep on improved pastures, whether the animals had been treated or untreated.

Mammal Coloration Simulating Environment.—In 1929, L. R. Dice described two pocket mice and a wood rat from New Mexico, the colours of which strikingly matched those of their rather peculiar and distinctive surroundings. A further study of the distribution of these forms, carried out by Seth B. Benson and two colleagues in the Tularosa Basin and the neighbourhood, has discovered three more rodents which tend to match the colour of the lava fields on which they live and to which they appear to be restricted. These new subspecies, which have been named *Citellus grammurus tularosæ*, *Perognathus intermedius rupestris*, and *Peromyscus nasutus griseus*, have not reached the degree of blackness of the lava-dwelling wood rat and pocket mouse, but appear to be intermediate stages between the ordinary colour and the black stage. They are described, with two plates, by Benson (*Univ. California Pub. Zool.*, vol. 38, 1932, p. 335).

Irish Euphausians.—Miss Winifred E. Frost in her work on the reproduction of *Nyctiphanes couchii* and *Meganyctiphanes norvegica* from off the south coast of Ireland (*Proc. Roy. Irish Acad.*, vol. 40, Sec. B, No. 14, 1931) investigates the breeding seasons of these euphausians and finds the larvæ of *Nyctiphanes* throughout the year with an April maximum. It probably has a spring and an autumn brood, whilst *Meganyctiphanes* apparently breeds in spring and summer with only one brood. As both these species, including the larvæ, form a large part of the food of herring, mackerel, and young hake, a detailed knowledge of their life histories is very important, and Miss Frost's observations give us some valuable information concerning the seasonal distribution of the larvæ. The area investigated lies off the south coast of Ireland and extends for about one hundred and fifty miles north and south, and for approximately two hundred miles from east to west, including both inshore and offshore waters. The main material consists of vertical plankton hauls taken with a Nansen net of two types, supplemented with occasional hauls with the Petersen trawl. It represents 31 cruises, spread over eleven years (1920–31). The distribution of the two species appears to be similar, although in the English Channel *Nyctiphanes* is usually found much nearer the coast than *Meganyctiphanes*. Both larvæ and adults occurred at one of the Irish stations with a depth of 150 metres. These two, both larvæ and adult, are the most frequent species in the plankton of the waters less than 100 fathoms deep off the south coast of Ireland, the distribution of the larvæ being 'patchy' without regard to depth or to a salinity range of 34·8-35·5 per mille. Only very general observations were made on vertical distribution, but the author found that the bulk of the calyptopis stages of *Nyctiphanes* are in the upper waters both day and night, whilst the older larvæ and adults were more abundant in the upper waters at night, which agrees with similar observations at Plymouth.

Fossil Marsupial from Africa.—Prof. E. Stromer, of Munich, has just described the first fragments of a fossil marsupial mammal from Africa (*Sitzungsb. Bayer. Akad. Wiss., math.-naturw. Abt.*, 1931 [1932], p. 177). They are portions of a lower jaw from a Middle Pliocene river-deposit south of Port Nolloth, Little Namaqualand, South Africa, and belong to an animal about as large as an ordinary rat. The dentition is sufficiently well preserved to show that the newly discovered species must have been closely related to the diprotodont marsupial *Cœnolestes*, which now lives in South America, and is represented by several extinct allies in the Tertiary rocks of Patagonia. The African form is generically distinct, and is named *Palæothentoides* by Prof. Stromer, who remarks on the interesting geographical distribution of the cænolestid group of marsupials which is thus extended.

Wood Anatomy in Mangrove Swamps.—Alexis J. Panshin has studied the Philippine mangrove swamps from a new point of view (*Phil. J. Sci.*, vol. 48, No. 2, June 1932). The trees found in these forests belong to very different families, but are all growing in a remarkably uniform and very characteristic habitat. Panshin, therefore, studied the anatomy of these woods to see whether their common structural feature suggested a direct connexion between habitat and anatomy. All of the woods were typically diffuse-porous and the vessels had usually comparatively small diameter. Apart from these two features, great diversity of structure was represented amongst the large number of species examined, and the author concludes, in agreement with Solereder, that habitat does not impress any definite type of anatomical structure upon species with a different evolutionary history.

Hypal Fusions in Dermatophytes.—Prof. A. H. R. Buller and his colleagues have devoted much attention to the study of hyphal fusions in various fungi. They have now turned their attention to a practical application of this knowledge ("Hyphal Fusions in Dermatophytes", by A. M. Davidson, Eleanor S. Dowding, and A. H. R. Buller, *Canadian Journal of Research*, vol. 6, No. 1, pp. 1-23, 1932). Studies on species of *Microsporon* and *Trichophyton*, which cause sores upon the skin and hair of human beings, have been made. It was found that hyphal fusions formed between any two mycelia of the same species isolated from different patients, but did not form between the hyphae of two different species. A simple method of hanging-drop culture was used to compare the behaviour of an undetermined fungus with that of a stock culture. This method gave a trustworthy criterion for the identification of species, and may prove of great use in the treatment of human skin diseases.

Earthquake Frequency at Kilauea.—The *Volcano Letter* for Feb. 4, issued at the Hawaiian Volcano Observatory, contains a remarkable curve representing the seismicity of Kilauea during the past four years. In estimating seismicity, shocks of intensities 1, 2, and 3 of the Rossi-Forel scale are given the weights 1, 2, and 3, very feeble shocks the weight ½, and tremors that scarcely show on the seismograph records the weight ¼. The number of tremors are occasionally very great, for example, 6531 and 10,080 during the weeks ending last Dec. 28 and Jan. 4, and, to keep the curve within reasonable limits, the logarithms of the weekly figures of seismicity are used. The outstanding features of the curve are the high peaks of suddenly increased activity that accompanied the four outbreaks of Halemaumau on Feb. 28 and July 25, 1929, Nov. 19, 1930, and Dec. 23, 1931, eruptions that were progressively more intense and lasting. The small oscillations tend to recur at intervals of from two to six weeks, with an average of 3·4 weeks.

The Granular Theory of Matter.—Volume 75 of *Memoirs and Proceedings of the Manchester Literary and Philosophical Society* contains the Dalton Lecture delivered before the Society by Sir J. J. Thomson on the occasion of his receipt of the Dalton Medal of the Society for his "eminent services to science", on March 17, 1931. The lecture was entitled "Atoms and Electrons", and in it Sir Joseph showed how the discovery that an electron moving with velocity u is always accompanied by waves of length equal to the quotient of Planck's constant h by the momentum mu of the electron, and of frequency proportional to the energy of the electron, had led him to the theory that matter was composed of granules of mass μ, less than 3×10^{-37} gm., all moving with the speed of light, the force on any granule being always at right angles to its path and producing therefore no change in the energy of the granule. When lines of electric force connecting protons and electrons link these granules together, the combination constitutes matter, and the mass of the proton or electron is the sum of the masses of the granules gripped by its lines of force, and the energy the sum of their energies. Further, if each granule is exposed to a succession of impulses ν_0 per second, the time of the impulses for each granule being arbitrary, for a mass m having m/μ granules the frequency ν of the disturbances will approximate closely to $\nu_0 m/\mu$ and the energy of the mass to $\nu\mu c^2/\nu_0$, which if we write h for $\mu c^2/\nu_0$ gives Planck's law.

Liquid Helium.—Prof. J. C. McLennan and some collaborators have published in the June number of the *Philosophical Magazine* some interesting photographs of liquid helium. The liquid was very quiet, and had a meniscus with an almost negligible curvature at the edge and scattered very little light. Examined for Raman spectra, it was found to exhibit no isolated modified lines; the intensity of any possible Raman line was certainly fainter than the weakest Raman line observed in the spectrum of the light scattered from liquid oxygen or liquid nitrogen. The unmodified lines were, however, accompanied by very faint wings, probably to be attributed to rotational changes in unstable helium molecules in the liquid, of a structure recently investigated by Weizel, and formed from a pair of helium atoms each in the normal $1S$ state. This work was done with the low temperature form of the liquid, the form boiling above about 38 mm. pressure being continually full of bubbles which caused large spurious scattering.

Excitation of the Nebular Spectrum.—A short note by H. Nagaoka and T. Futagami (*Proc. Imp. Acad. Japan*, March) contains the announcement of the production in the laboratory of a fresh part of the nebular spectrum. An arc was run between carbon poles in nitrogen or oxygen which had been partly dissociated and ionised previously by causing it to pass through a hole in the carbon. The arc was spread out sideways by a magnetic field, and an auxiliary condensed discharge passed through it, between silver electrodes, at a distance of 15 cm. from the axis of the main poles. The luminosity of the auxiliary discharge extended somewhat towards the carbons, but the more remote parts were free from the bands of carbon monoxide and nitrogen, and showed only silver lines and lines of ionised oxygen and nitrogen. It is stated that the latter included many found in nebulæ and ascribed by Bowen to singly charged oxygen and nitrogen (O II and N II) and to doubly charged nitrogen (N III). The lines coming from doubly charged oxygen (O III) were not observed.

Structure of Tetramminoplatinous Chloride.—Werner's view that the 4-co-ordinated compounds of bivalent platinum possess a planar configuration, the four groups occupying the corners of a square with the platinum at the centre, has been several times contested. Pauling has, however, shown theoretically that the bivalent transitional elements nickel, palladium and platinum can form such compounds with a planar configuration, and, apart from available evidence of a purely chemical nature, his conclusions are supported by investigations on the nickel derivatives of benzylmethyl glyoxime and the X-ray analysis of K_2PdCl_4 and K_2PtCl_4, in which the metal occurs in the anion. Cox (*J. Chem. Soc.*, June) has now shown by X-ray analysis that the same configuration also occurs in the cation, $Pt(NH_3)_4$, of the salt $Pt(NH_3)_4Cl_2, H_2O$, and it appears fairly certain that the bonds to any four identical groups co-ordinated to a platinum atom lie in a plane. The compound in question forms an ionic lattice with one molecule in the unit cell, and the symmetry requires that the ammonia groups are rotating about the covalent bond. The water molecules are loosely held and can be expelled without disrupting the crystal: the best position is probably with the oxygen atom at the centre of the cell. Each platinum atom is surrounded by four ammonia groups in a square and at a greater distance by eight equidistant chlorine ions. Each ammonia group is at the centre of four coplanar chlorine ions, while each chlorine ion is surrounded by eight ammonias.

Astronomical Topics

Comets.—Dr. A. Dubiago gives a definitive orbit for Brooks's periodic comet at its last return, and a predicted one for this year, in *Astr. Nach.* 5874:

T	1925 Nov. 1·729463 U.T.		1932 Oct. 7·5519 U.T.	
ω	195° 30′ 57·33″	1925·0	195° 48′ 18″	1932·0
Ω	177 25 11·60		177 27 11	
i	5 33 11·07		5 32 52	
ϕ	29 8 36·20		29 4 7	
n	513·27574″		511·654″	
log a	0·5597706		0·56075	

An ephemeris from June 5 to Dec. 30 is given; it is very close to that of Mr. F. R. Cripps in the B.A.A. Handbook; Mr. Cripps applied perturbations by Jupiter and Saturn (Dubiago applied those of Jupiter only), and obtained T Oct. 7·623, differing from the other by less than two hours. The conditions this year are very favourable, the comet being in opposition at its perihelion.

The *Journal des Observateurs* for May contains a study by Dr. A. Schaumasse of the periodic comet Borrelly, which has been seen at each return since its discovery in 1905; he has applied perturbations by Venus, Earth, Mars, Jupiter, Saturn, and finds the elements;

T	1925 Oct. 7·53664 U.T.		1932 Aug. 27·79623 U.T.	
ω	352° 25′ 34·11″	1930·0	352° 33′ 6·74″	1930·0
Ω	77 6 12·17		77 2 3·63	
i	30 30 39·83		30 31 47·18	
ϕ	38 3 26·35		38 4 59·78	
n	515·33164″		516·11281″	
Period	6·885251 y.		6·874830 y.	

T in 1932 is 1·8 days later than the value used in the ephemeris in the B.A.A. Handbook. The comet will be well placed as a morning object for northern observers in September and October; a misprint in the Handbook should be corrected. Read 352°, not 325°, for ω.

Slopes of the Lunar Mountains.—Mr. T. L. MacDonald has been contributing a series of papers on lunar statistics to the *B.A.A. Journal*; the issue for May contains a study of the slopes of mountains, which is based on examination of the shadows at different altitudes of the sun. The mean value of the inclination is deduced as being slightly less than 30° for the larger craters, but attaining 36° for those with diameters less than 40 km. Mr. MacDonald states that 30° is the angle at which equilibrium of loose debris is possible. In view of the disturbing effect of the great range of temperature between day and night, the older formations would probably have had time to reach equilibrium; but it is suggested that the small formations may have been the latest, and that there has not yet been time to reach a state of equilibrium. Many of the objects in question are near the borders of the maria, which are likely to be areas of weakness where disturbances may have continued to a later period than in more stable regions.

Mr. MacDonald's work shows that observers need not consider that the moon's surface is so well known that nothing more remains to be done. Visual work can give more continuous records of the changing aspects of the shadows than can be done by photography, in view of the great number of plates that the latter would require.

University Statistics *

THE comparative statistics recently issued by the University Grants Committee for the academic year 1930–31 relate to the twelve universities of England and Wales with their colleges, the independent university colleges of Exeter, Nottingham, and Southampton, the Manchester College of Technology, the four Scottish universities, and the Royal Technical College, Glasgow. The tabular statements, which compress into twenty pages a vast amount of information regarding the finances, students, staffs, and libraries of these institutions, are preceded by an introductory note directing attention to a number of figures of special significance.

Of the 47,587 full-time students included in the returns, 33,569 were in England, 2868 in Wales, and 11,150 in Scotland. Of those in England, nearly a third were at Oxford (4658) and Cambridge (5599), a third at London, and rather more than a third at provincial universities and colleges. One of the tables, entitled "Home and University Residence of Full-time Students", affords a factual basis for criticising certain theories put forward in a recent discussion in the *Universities Review* of the question "What is wrong with the Modern Universities?" It has been suggested that they fall short of what has been expected of them through being too intensely local and through being, in the main, non-residential. The table shows that Bristol and Reading universities and Exeter, Southampton, Aberystwyth, and Bangor university colleges draw more than half of the total number of their full-time students from homes more than thirty miles distant, and can therefore scarcely be described as predominantly 'local'. It shows, too, that Reading, Exeter, and Southampton accommodate more than half their full-time students in colleges or hostels, and may therefore fairly claim to be considered 'residential'. Excluding London, where the proportion of students so accommodated is small, 52 per cent of the full-time women students and 36 per cent of the men were in colleges or hostels.

The same table shows also how many of the full-time students came from homes outside the British Isles but within the British Empire (2759) and how many were from foreign countries (1809). The percentage of foreign students has increased in recent years.

As regards the character of the work in which university students were engaged, they are graded in Table 3 as 'advanced' (including research workers), 'first degree', and 'diploma'. Full-time students were distributed among these grades as follows: 2237; 36,886; 8464. The table includes also particulars of 14,725 part-time students, of whom 8280 were not classifiable under the above grades, as the courses they followed did not lead to degrees or diplomas: more than half of these were in London (chiefly University and King's Colleges and the London School of Economics) and Glasgow (Royal Technical College). A further indication of the standard of work is afforded by the number of higher degrees (excluding those granted without examination), namely, 1323, and higher diplomas, 346.

Fields of study are demarcated in five compartments: arts (including theology, fine art, law, music, commerce, economics, and education), pure science and mathematics, medicine (including dentistry), technology (including engineering, applied chemistry, mining, metallurgy, architecture, etc.), and agriculture. The distribution of the general body of full-time students was: arts 51·8 per cent, medicine 20·8, pure science 16·5, technology 9, agriculture 1·9; but taking advanced students alone, the pure science group is the largest (42·6 per cent), followed by arts (38·4), medicine (7·6), technology (9·7), and agriculture (1·7). The following table gives the names of the universities in which the pure and applied science groups (excluding medicine) were most numerous:

Pure Science.		Technology.		Agriculture.	
Cambridge	1168	London:		Reading	190
Oxford	569	Imp. Coll.	602	Cambridge	157
Manchester	530	Univ. Coll.	265	Edinburgh	133
London:		Cambridge	568	Oxford	99
Univ. Coll.	518	Liverpool	326	Aberdeen	74
Imp. Coll.	376	Glasgow	304	Aberystwyth	58
Glasgow	429	Manchester:			
Liverpool	295	Coll. of Tech.	272		

Of the advanced work in pure science, four-fifths was in chemistry and physics.

The financial statements show incomes amounting in the aggregate to nearly six million pounds, as follows:

London	£1,607,140
Oxford and Cambridge	1,053,477
English Provincial Universities and Colleges	1,960,153
Wales	346,768
Scotland	863,389

These figures include the addition to the Treasury grant voted by Parliament in 1930 for the quinquennium beginning 1930–31, and show therefore a considerable advance upon the figures for the previous year. Parliamentary grants, together with grants from local authorities, now constitute on an average 45 per cent of income in England, 67 per cent in Wales, and 43 per cent in Scotland. Thanks to the addition to the grant, only ten of the fifty-two institutions ended the year with deficits, and the aggregate amount of these was but £11,403.

Expenditure on libraries, which is exhibited in some detail in a special table, amounted to four per cent of the total expenditure, and more than ten per cent of it was for purchase of learned journals. Commenting on this, the committee observes that "the most serious and perplexing problems which at present exercise the minds of librarians all the world over are those which arise out of the increasing number and cost of periodicals".

* University Grants Committee: Returns from Universities and University Colleges in receipt of Treasury Grant, 1930–31. Pp. 28. (London; H.M. Stationery Office, 1932.) 1*s*. 0*d*. net.

Condensed and Dried Milk *

DR. L. A. ALLEN, of the recently founded Hannah Dairy Research Institute, has brought together and reviewed, in the publication before us, the facts relating to the preparation of condensed and dried milk products. The pamphlet appears at an opportune time, since for reasons of national economy efforts are now being made in Great Britain to increase supplies of home-produced foods. Large amounts of condensed and dried milk are imported annually into the country, the totals for 1931 being given as 2,700,000 cwt. and 250,000 cwt. respectively.

Just as in the case of the commercial canning of

* The Hannah Dairy Research Institute. Bulletin No. 3: The Properties of Milk in relation to the Condensing and Drying of Whole Milk, Separated Milk, and Whey; a Review of existing Knowledge. By Dr. L. A. Allen. Pp. 159. (Auchincruive: Hannah Dairy Research Institute, 1932.) 4*s*. 6*d*. net.

fruit and vegetables, where at the present time, by improvements in technical methods and the organisation of suitable supplies, an important industry is developing, so in the condensation of milk—whether to furnish evaporated (unsweetened) milk, sweetened condensed milk, or dried milk—development ought not to be difficult. The first requisite for such development is a knowledge of the raw material, and in Part 1 of the bulletin an account is given of the influence of the various components of milk in condensing and drying. Part 2 deals with the colloidal properties of milk, as these are important with reference to coagulation by heat in the manufacturing processes, and in the alcohol test, by which the suitability of milk for condensing is judged. The influence of heat on milk, both as regards the bacterial flora and changes of a chemical nature, are discussed in Part 3, and the effect in both cases is shown to have important bearings upon factory methods and upon the final product.

The manufacture of sweetened condensed milk is, as would be expected, described fully, the technical operations first being outlined. Sections on the bacteriology of the product, the control and testing of the raw milk, the bacterial flora of milk, all give a good résumé of the present state of knowledge. In the last section of Part 4 are described the defects in condensed milk, due on one hand to micro-organisms and on the other to chemical or physical changes.

In Part 5 evaporated milk is dealt with in a similar manner, and in Part 6 dried milk; in the latter Part the composition and properties of milk powders are discussed especially with reference to keeping qualities.

The waste of valuable food material in the whey from cheese factories—the loss has been estimated to be about £1,000,000 annually in Great Britain—has occasioned much thought, and a certain amount of research work has been undertaken, but so far no commercially successful method of utilising the whey has been put into operation. What has been achieved is recorded in Part 7, and it seems very probable that with the knowledge now available and the perfecting of the engineering details a food capable of being used in the confectionery and sweet trades will be manufactured economically.

The final part of the bulletin discusses the uses of condensed milk and dried milk in the household and in industry.

The writer of the bulletin—Dr. L. A. Allen—is to be congratulated upon the thoroughness with which he has gathered together the material, and upon the skilled and critical manner in which he reviews it. In each section the points having a bearing upon the subject under discussion are clearly brought forward.

Altruism in Science and Industry

UNDER the title "Science and Industrial Sanity", in the *Hibbert Journal* for July 1932, Mr. H. P. Vowles and his late wife, Margaret Vowles, discuss some of the effects of the application of science to industry during the last century and half, particularly the enormous increase in productivity and the unaccompanying unemployment. They reject at the outset the pleas for a return to the pre-scientific age or for the suspension of scientific research and its application to industry for several decades, and point out that the spectacular increase in productive capacity has been accompanied by a considerable change in the ethical standards of industry. Wherever science has influenced industrial activity, the spirit of service has come into competition with the desire for private gain. The serious problems with which mankind is now confronted are mainly attributed to the existence of whole tracts of industry, notably those concerned with the monetary aspects of distribution, which are uninfluenced by science, and where alike the scientific method and the spirit of service have yet to penetrate.

In support of their contention, the authors refer to the noble tradition of science that the service of mankind should be given precedence over personal advancement, and to the part played by the engineer in the permeation of industrial activities with the ideal of public service. Engineering institutions and societies have all adopted the attitude that though engineers must normally earn a living by their work, the primary purpose of engineering activity is the service of mankind. Political economy similarly became imbued with the idea that co-operation is a nobler ideal than self-interest, and to-day the idealism of the engineering societies is only one of the indications that as industry becomes more influenced by science the obligation upon all to subordinate self-seeking to the common good becomes more widely acknowledged.

Accordingly, with this change in mind, it is possible to view without dismay the enormous increase in the power resources affecting not only manual but also clerical labour, or the realisation that the mechanical invasion of mankind is only in its initial stages. The penetration of science to the world's monetary and distributive systems is bound to follow; and beyond this, the complete permeation of industry by science, involving the attainment of higher educational levels for all and producing a saner work-day environment, should be of considerable assistance in guiding men to sane uses of the leisure which will be available for all in the completely scientific State. Such rationalisation and reorganisation necessarily involve a very wide margin of leisure for all, but if science enables men to see industry in its right perspective and themselves in their right relation to industry and to one another, the fear that leisure will be used unwisely in the scientific State may never be justified in the event. Nor need we dismiss as utopian the suggestion that science and machinery, and the leisure they make possible, are destined to play an indispensable part in lifting men to new and higher levels of endeavour and achievement.

Development of the 'Grid' in Great Britain

AN address by Sir Archibald Page, chief engineer of the Central Electricity Board, on the 'grid' for electric supply in Great Britain was given recently to the Electrical Association for Women (the *Electrical Age*, July). Sir Archibald points out that there are three main stages of getting electricity to the consumers' terminals, namely, generation, transmission, and distribution. The Central Electricity Board is primarily concerned with the first and in a less degree with the second of these stages.

At the beginning of this century, engineers recognised that electricity can be produced much more cheaply in large quantities, and that electricity is the most convenient agency for the transmission of power, heat, and light. Companies possessing several stations found it advantageous to link them together. The outbreak of the War and the subsequent increased demand for power led to the appointment of the Electricity Commission to regulate and promote the production and distribution of electricity in accordance with modern ideas.

In 1925 the Weir Committee recommended the

establishment of a system of main transmission lines called the 'Grid Iron' for the purpose of interconnecting the principal generating stations of Great Britain, and in due course proposed the shutting down of less efficient stations. To effect this, a new organisation called the Central Electricity Board was set up to manage what may be called the 'wholesale' side of the supply industry. This Board is now hard at work accelerating the completion of the 4000 miles of transmission line and the numerous transforming and switching stations involved, and is already well ahead of its original programme.

Although on technical and financial grounds it was advisable to use overhead lines, it was necessary to use a considerable mileage of cable, mainly in the London district. The value of the orders given by the Board to British firms now exceeds 22 million pounds. This has reacted on unemployment figures and the electrical industry is one of the few flourishing industries in the country. The Board is in no sense a government department. It is part of the supply industry and is financially self-supporting.

Great Britain with its dense population, diversified industries, cheap coal, and extensive coast-line is an ideal country to electrify. What is needed is an efficient organisation to ensure that expansion of output which will bring cheap electricity to the consumer. The field is wide. Only about 65 per cent of the machinery utilised in industry is electrically driven. There are eleven million potential consumers in Great Britain and only about four and a quarter million are connected with the supply mains.

Sir Archibald Page pointed out that Great Britain was the first country to lay down a national system of electric trunk mains. It was now almost impossible to make a train or car journey of any distance without seeing some of the lattice steel towers supporting the electrical conductors which constitute the 'grid'.

University and Educational Intelligence

CAMBRIDGE.—At Emmanuel College the studentship offered for competition to graduates of other universities intending to commence residence as research students in October has been awarded to L. Belchetz, Rhodes University College, Grahamstown, South Africa (chemistry). The studentship held by J. W. Harding (Victoria University College, Wellington, New Zealand) for mathematical physics has been renewed for a third year. Internal studentships offered for competition to members of the college have been awarded as follows: B. V. Bowden (physics) for one year, A. J. Ward (mathematics) for two years.

LONDON.—The following degrees have been conferred: D.Sc. in biochemistry on Manayath Damodaran (Imperial College—Royal College of Science) for a thesis on "The Amino-Acids of Gluterin" (*Biochem. J.*, 1931), "The Dicarboxylic Acid Nitrogen of Proteins" (*Biochem. J.*, 1931), and "The Isolation of Asparagine from an Enzyme Digest of Edestin" (*Biochem. J.*, 1932). D.Sc. in chemistry on Ranchhodji Dajibhai Desai (Imperial College—Royal College of Science) for a thesis entitled "The Influence of Methylcyclopentane and Methylcyclohexane Rings on Carbon Tetrahedral Angle" (*J. Chem. Soc.*, May 1931 and April 1932). D.Sc. in mining geology on Mr. G. C. A. Jackson (Imperial College—Royal School of Mines) for a thesis entitled "The Geology and Ore-deposits of the N'Changa Mine and District, Northern Rhodesia", a portion of which, entitled "The Ores of the N'Changa Mine and Extensions, Northern Rhodesia", has been published in *Economic Geology*, vol. 27, No. 3, 1932. D.Sc. in psychology on Mr. S. J. F. Philpott (University College) for a thesis entitled "Fluctuations in Human Output" (*Brit. J. Psych.*, 1932).

IT is announced that the Prudential Assurance Company has offered to contribute £1500 a year for a term of seven years to the London School of Hygiene and Tropical Medicine. The suggestion that the contribution shall be directly associated for the duration of the gift with the University chair of public health has been accepted by the governors of the School.

THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 has made the following appointments to Overseas Scholarships for 1932:—On the recommendation of McGill University: Mr. J. F. Heard (physics, Imperial College of Science and Technology, London), Mr. M. K. McPhail (biochemistry, National Institute for Medical Research, London); on the recommendation of Queen's University, Kingston: Mr. W. J. Henderson (physics, University of Cambridge), Mr. G. S. Farnham (metallurgy, University of Manchester); on the recommendation of the University of Melbourne: Mr. A. B. Edwards (geology, Imperial College of Science and Technology, London); on the recommendation of the University of Sydney: Thelma M. Reynolds (organic chemistry, University of Oxford); on the recommendation of the Universities of Cape Town and the Witwatersrand: Dr. E. C. Halliday (physics, University of Cambridge and the Experimental Station of the Radio Research Board, Slough); on the recommendation of the University of New Zealand: Mr. R. M. Barrer (physical chemistry, University of Cambridge).

Calendar of Geographical Exploration

Aug. 10, 1537.—De Vaca and the Gulf of Mexico

In 1528, Cabez de Vaca had accompanied Pamfilo de Navarez on an expedition which landed on the west coast of Florida near Tampa Bay. In a subsequent march they lost touch with their ships and the party broke up. In the winter of 1528–29, of a party of 80 on the 'Island of Misfortune' off the coast of Texas, only 15 survived. De Vaca was one; he crossed to the mainland and spent five years among the natives. Then, with a companion, he travelled south, crossing the Brazos and Colorado Rivers and reaching San Antonio Bay. Ultimately he reached Mexico City and returned to Europe, arriving at Lisbon on Aug. 10, 1537. His account of the riches of the region which he had visited resulted in the journeys of Coronado and de Soto.

Aug. 11, 1901.—Kaiser Wilhelm II. Land

Prof. von Drygalski left Kiel on Aug. 11 in the *Gauss*, reaching Kerguelen Island on Dec. 31, where a party of German scientific workers had landed a few months earlier and had set up an observatory. The *Gauss* wintered in the ice, and a sledging party discovered the land named Kaiser Wilhelm II. Land, with a hill 1500 ft. high, which was named the Gaussberg. The expedition not only discovered new land, but also recorded many valuable scientific observations.

Aug. 12, 1767.—Carteret's Discoveries in the Pacific

Capt. Carteret in the *Swallow*, after discovering Pitcairn Island, reached the Santa Cruz group. Although these islands had been discovered by Mendaña a century before, their position was but imperfectly known and Carteret may be credited with their rediscovery. Later the group now known as the Carteret

Islands was discovered, though Carteret himself identified them wrongly. Carteret's most important discovery was that the strait between New Britain and New Ireland was a channel and not a bay, as Dampier had concluded. Other small islands were discovered and the south coast of Mindanao was examined, the *Swallow* returning home in 1769.

Aug. 13, 1829.—The North Magnetic Pole

Sir John Ross in the *Victory*, accompanied by his nephew, James Clark Ross, in a ship fitted up by Sir Felix Booth, reached Fury Beach, where Parry had abandoned the *Fury* in 1825. Their object was to find the north-west passage. In this they failed, but the land called Boothia in honour of Sir Felix Booth was discovered, and James Clark Ross, by means of sledge journeys, located the north magnetic pole in 70° 5′ 17″ N., 95° 46′ 53″ W., on the western coast of Boothia. He also discovered and named King William Land and surveyed its northern shore. Their boat was frozen in during its first winter and the Rosses were unable to extricate it. They thus spent four winters in the region, when fortunately they were picked up by a whaling vessel in Lancaster Sound, which they had reached by boat. This whaler, the *Isabella*, was the same ship in which J. C. Ross made his first voyage to the arctic regions in 1818. J. C. Ross in 1839–43 did magnificent work in the antarctic. (See Calendar for Jan. 1.)

Societies and Academies.

DUBLIN

Royal Dublin Society, May 24.—Irish Radium Committee Report for the year 1931. 16,756 millicuries of radon were issued during the year for therapeutic purposes. Detailed reports from some of the largest users record the results of the treatment of 400 cases.—**J. Stuart Thomson**: The anatomy of the tortoise. A study of the morphology of the closely allied species, *Testudo ibera* and *T. græca*, system by system, in a way never attempted in a chelonian since the classic work of Bojanus on *Emys europæ* in 1819. The dissections of the vascular system from injected specimens, showing the complicated connexions of the arteries and veins related to the carapace, are some of the important features. Transverse sections of a six-weeks-old *Testudo* cut in celloidin are figured. The author recommends the importance of some dissections from the dorsal surface, after dissolving away the carapace with acid.—**W. E. Abraham**: Contact angles in an oil-water interface and their application to free flotation in the Weva inclinometer. In this instrument a floating magnet is used to determine the magnetic meridian. The magnet is encased in ebonite coated with gutta-percha, which lies in an oil-water surface in a containing glass vessel. As the water does not wet the gutta-percha, capillary repulsion ensures free rotation.—**J. Lyons** and **G. T. Pyne**: Factors affecting the body or viscosity of cream and relative matters. Data are presented to show the effect of separation temperature, previous chilling, and pasteurisation of milk, and re-separation of chilled pasteurised cream on the viscosity of the ultimate product.

EDINBURGH

Royal Society, June 20.—**Pierre Rijlant**: Automatism and conduction in the mammalian heart. The contraction of the heart starts in the sinus region. This initial activity is accompanied by mechanical and electrical changes limited to the sinus. The cathode ray oscillographic records of the pacemaker's activity show a series of electric waves, each of them being localised to a limited region of the sinus. The initial wave appears in a limited spot situated at the venous side of the sinus and corresponding to the embryological remnant of the right duct of Cuvier. The transmission of this initial activity to the auricle occurs through a differentiated contractile conduction system. In the mammalian heart automatism and rhythmicity occur in a limited region with characteristic structure. These regions are contractile and their contraction is independent from that of the myocardium. Transmission occurs through a differentiated system which unites the different segments of the myocardium.—**L. Hogben**: Filial and fraternal correlations in sex-linked inheritance. When inheritance is sex-linked, the correlations of relatives differ from those based on the more typical mode of transmission, and differ according to the sex of the pairs. As compared with filial correlations of the Pearsonian type, the correlation for father and son is zero, for mother-daughter it remains unchanged, and for father-daughter or mother-son it is raised. The correlation for brother-sister is lowered as compared with Pearson's fraternal coefficient. For brother-brother it remains unchanged and for sister-sister it is raised. From the formulæ given it is seen that no comparison between twin correlation is valid unless the sex composition of the groups compared is identical. In addition, it is seen that a study of correlation between relatives classified in every possible way with respect to sex could provide a means of estimating the contribution of sex-linked genes to the observed variants in a population.—**A. Graham**: On the structure and function of the alimentary canal of the limpet. In *Patella vulgata* the radula, lubricated by the salivary secretion, scrapes the food particles, mainly diatoms and small algæ, off the rocks on which the animal is living, and conveys them to a ciliated food channel running down the fore-gut. Into this channel ciliary currents convey an amylolytic enzyme secreted by side folds in the same region. The mixture of food and enzyme is absorbed by absorbing cells in the digestive gland. The rest of the alimentary canal, of which five histologically different portions may be distinguished, is chiefly concerned with elaborating the waste matter into rod-shaped fæcal masses.—**S. M. K. Henderson**: Notes on Lower Old Red Sandstone plants from Callander, Perthshire. South of Callander, plant-bearing flagstones occupy the centre of a great syncline, and are exposed in the area between the Rivers Teith and Forth. The following have been obtained from an exposure in the Tarr Burn at Ballanucater Farm: (1) *Pachytheca* sp.; (2) *Arthrostigma gracile*, Dawson; (3) *Psilophyton*, Dawson, and associated remains that may belong to the one plant. Those included under (3) may be grouped into (*a*) spiny stems, (*b*) slender spineless dichotomous branch-systems, (*c*) stout and slender branch-systems with axillary structures. The consideration of these remains has raised two questions: Does the association of plants of type (*b*) with those of type (*a*) indicate the appearance of *Hostimella*-like plants in the Lower Old Red Sandstone, or may they be classed under some such form as *Psilophyton goldschmidti*? The second question concerns the demonstration of axillary structures in some of the branch-systems (*c*). Do they belong to spiny axes of *Psilophyton* type, or do they indicate the presence of another type that would have to be classed as *Hostimella* sp.?

PARIS

Academy of Sciences, June 20 (vol. 194, pp. 2181–2248).—**H. Douvillé**: Notice on the work of Albert de Grossouvre.—**C. Matignon** and **M. Léon**: The thermo-

chemistry of the calcium orthophosphates.—**Louis Blaringhem**: The inheritance of sex in meadow sage (*Salvia pratensis*). Although the author has been unable to establish a line of *S. pratensis* containing only female descendants, it is probable that in six generations the percentage of individuals of this sex could be raised to 90 per cent.—Jean Tilho was elected a member of the Section of Geography and Navigation in succession to the late General Ferrié. Jean Cabannes was elected *correspondant* for the Section of Physics.—**Jean Bosler**: The apparent rarity of hyperbolic comets.—**A. Buhl**: Multipoint movements corresponding to the Schrödinger equation written for the case of a single point.—**C. Courty** and **C. Chéneveau**: The direct measurement of the magnetic susceptibilities of liquids, by the Curie-Chéneveau magnetic balance. Data are given for carbon tetrachloride, chloroform, alcohol, and pyridine.—**T. N. Panay**: The realisation of a black body at the boiling point of metals. A method of obtaining black body radiators at fixed temperatures. Details are given of the construction of a black body radiator working at the boiling point of zinc.—**J. Gilles**: The variation in the wave-length of lines emitted by a copper arc of great intensity. The stability of the arc was ensured by using a brass anode and graphite cathode. Three wave-lengths were studied, 5218, 5153, and 5105. The last showed no change, but the first two showed displacements of the same order.—**F. Wolfers**: The possibility of a Compton effect in optics. From a mathematical study, the trajectories of the photons are reflected and refracted at the surface of separation of two media in such a manner that the frequency of the photons remains invariable. Hence in interference phenomena there is no difficulty due to the Compton effect.—**Marcel Cau**: The interpretation of the experiments of Pogány; the influence of the thickness.—**S. V. Sze**: The magnetic spectrum of the β-rays emitted by $ThC + C' + C''$. Details of measurements of 28 lines, half of which are new.—**Mme. Irène Curie, F. Joliot**, and **P. Savel**: Some experiments on the radiations excited by the α-rays in light bodies. Experiments on the action of the α-rays on lithium and beryllium.—**Francis Perrin**: The possible emission of demi-helions during certain induced radio-activities. The possibility of the existence of a demi-helion, resulting from the reunion of a proton and a neutron (mass 2, charge 1) is discussed, and some consequences deduced.—**Pierre Dubois**: The reduction of permanganate by manganese sulphate. Study of the variations in oxygen content of the precipitate produced by changing the amount of permanganate and the pH of the liquid.—**M. Battegay** and **L. Denivelle**: Aminosulphonamide or sulphamide, $SO_2(NH_2)_2$.—**P. Carré** and **D. Libermann**: Thionylaniline as a reagent in organic chemistry. Its use for the characterisation of acids as anilides. Thionylaniline may serve to identify many acids as anilides. Cases are described for which the method is unsuitable.—**Mailhe** and **Creusot**: The thermal decomposition of isopentane in the presence of silica gel. At 680° C., with silica gel as catalyst, for 15 seconds heating, isopentane gives 75 per cent gaseous products and 25 per cent liquid rich in ethylenic and aromatic hydrocarbons.—**Paul Gaubert**: Tints due to the pleochroism of crystals and of artificially coloured spherolites.—**N. Stoyko**: The periodic displacements of continents. A discussion of the periodic variations of longitudes of various observatories. The period of the variation is about eleven years, the same period as the sunspot variation.—**Ernest Esclangon**: Remarks on the preceding communication.—**G. A. Nadson** and **C. A. Stern**: The action at a distance of metals on micro-organisms. A continuation of previous work on the same subject. The action of the metal is stronger (that is, the colonies developed are fewer) as the atomic number of the metal increases. The possible cause of this action is discussed; it is not due to the production of ozone or of hydrogen peroxide.—**J. M. Lys**: The composition and evolution of the reserves in *Cyclamen latifolium*.—**E. Sollaud**: The development of *Palæmonetes mesopotamicus* compared with that of other *circa*-Mediterranean *Palæmonetes*.—**Emile Terroine, Mlles. Marguerite Champagne** and **Gilberte Mourot**: The distribution of the urinary type of nitrogenous metabolism in various species of mammals during the minimum of specific endogenous discharge.—**Jules Amar**: Conclusions on hydrothermal metabolism.—**A. M. Monnier** and **H. H. Jasper**: The action of the centres on the various characteristics of the nerve fibre. The analogy with electrotonus.—**J. Lignières**: The causes of the attenuation and exaltation of the aphthous virus. Recurrence in aphthous fever. The choice of virus for antiaphthous vaccination.

MELBOURNE

Royal Society of Victoria, April 14.—**G. F. Hill**: Australian *Rhinotermes* (Isoptera). The first two species described, *Rhinotermes intermedius* Brauer and *R. reticulatus* Froggatt, are regarded as being specifically distinct, whilst the remaining hitherto described species, *R. breinli* Hill, is proposed as a subspecies of the former. Three new subspecies are described, namely: *R. intermedius seclusus*, *R.i. actuosus*, and *R.i. derosus*, as in the soldier caste (two forms) of Brauer's species. Comparative measurements of species and subspecies of *Rhinotermes* are given.—**R. B. Withers**: A new genus of fossil king-crabs. The author described a new genus and species of fossil king crabs, *Rutroclypeus junori*, from the Silurian, Kinglake West, Victoria. The relatively large dorsal shield and long tail spine are adaptations to the animal's burrowing habits.—**C. W. Brazenor**: A new record of a beaked whale (*Mesoplodon*) from Victoria. This is the first discovery of *Mesoplodon grayi* Haast on the Victorian coast. The upper half of a skull and two caudal vertebræ were found at Cape Schanck, near Flinders.

ROME

Royal National Academy of the Lincei, Feb. 21.—**U. Cisotti**: Motion with 'wake' of a flexible profile; dynamic actions (2).—**G. Abetti**: Altitude of the chromosphere in 1931. For the mean height of the chromosphere during 1931, observations at Arcetri on 118 days give the value 9·84″, whereas those at Madrid on 29 days give 10·14″. The former indicate diminution of 0·44″ in comparison with 1930, and the latter an increase of 0·33″, the latter result being probably due to the small number of observations made. As was previously noted, the value is highest at the poles and lowest at the equator. The observations at Arcetri, Catania, Madrid, and Zurich show that the total area of the prominences, measured in units of prominence, diminished by 68 from that of 1930, whilst for the preceding year the decrease was 291. In 1931 the maximum frequency of the prominences is shown in both hemispheres at latitude 45°, this being regarded as an indication of the commencement of a new cycle.—**E. Paternò**: (1) Cryoscopy and molecular weight of polymerides of carbohydrates. Cryoscopic determinations of the molecular weights of derivatives of cellulose and analogous products are regarded as valueless.—(2) Cellulose in Schweitzer's reagent. The preparation of a solution of cellulose in Schweitzer's reagent, without previous preparation of this reagent, is described. In this way a solution is obtained which is much richer in cellulose than those made in the ordinary way.—(3) Cellodextrin, amyloids, and pentosans.—**L. Cambi, L. Szegö**, and **A. Cagnasso**:

Magnetic behaviour of complex compounds. (4) Ferric $N:N$-dipropyl dithocarbamates. The results now given refer to the di-n-propyl, n-propyl-isopropyl, and di-isopropyl compounds.—**G. Andreoli**: Reciprocal pairs of V_3: laws of duality of the linear and tangential metrics, of parallelism, and of metrism. (1) Variational problems.—**Patrick Du Val**: Surfaces of one kind which are not bases for a system of quadrics.—**Luisa Pelosi**: Levi-Civita's parallelism.—**C. Antoniani and F. Zanelli**: Investigations in the phytosterol group: Sterols of grape-seed oil. When the crude sterol product of grape-seed oil is subjected to acetylation and bromination according to Windaus's method, a single soluble bromo-acetyl derivative is obtained. The presence of stigmasterol and analogous sterols is thus excluded.—**A. Corbellini and C. Pizzi**: Stereoisomerism of 2 : 2′-disubstituted derivatives of diphenyl. The resolution of 2-[bisphenylmethoxy]-2′-diphenylcarboxylic acid into its optical antipodes is described.—**Z. Jolles**: Diazo-resins (1). Diazo-resins obtained, usually together with the corresponding aromatic hydrocarbons, from the normal diazohydrates of aniline, *m*- and *p*-toluidines, *o*- and *p*-anisidines, *o*- and *p*-phenetidines, *o*- and *p*-aminobenzoic acids, and α-naphthylamine in presence of sodium hydroxide, are described. The nitrogen contents of the products are mostly in good agreement with those calculated from the equation (for aniline), $4C_6H_5.N_2OH = C_{24}H_{18}ON_2 + H_2O + 3N_2$. The resinification seems to result from internal oxidation of the diazo-compounds.—**A. Rossi**: Crystalline structure of praseodymium. X-ray examination by the powder method of a specimen of praseodymium (of 99·4 per cent purity) gives the value 1·62 for the axial ratio $c : a$ and 3·657 A. for the side of the unit cell. The calculated density is 6·777, the experimental value being 6·765 ± 0·008. Good agreement is shown between the calculated and observed intensities of the spectral lines.—**F. V. Madon and S. Goldberger**: The adrenaline blood-sugar curve during fatigue and the potassium-calcium ratio. The experiments described were made on four individuals. Fatigue is accompanied by a marked increase (15-20 per cent) in the potassium content of the blood, the calcium content remaining constant. The influence of fatigue on the action of adrenaline on blood-pressure shows irregular and individual variations. The blood-sugar is, however, always markedly lower after labour than during rest.—**A. Baroni**: Existence of polythionic chlorides: determination of the refractive indices of solutions of sulphur in sulphur chlorides. Measurements have been made of the refractive indices of mixtures of sulphur with sulphur chlorides (SCl_2 and S_2Cl_2) heated to 100°, 150°, or 200°, and of the same mixtures after these have aged for about six months. The results render probable the existence of a polythionic chloride S_3Cl_2, and seem to exclude the existence, within this range of temperature, of compounds richer in sulphur.—**G. Piccardi and A. Sberna**: Molecular spectra and spectroscopic analysis. (3) Investigations on yttrium. Yttrium monoxide, YO, obtained by volatilising any yttrium compound, exists as such in the oxy-hydrogen flame, and yields a spectrum composed solely of bands of the monoxide and free from atomic lines. The orange and red regions show two systems of irresolvable narrow bands with origins at λ5972 and 6132, and a vast system of wide bands with origin at about λ4817, these being resolvable into lines by a powerful apparatus.—**G. Checchia-Rispoli**: *Sanfilippaster*, a new genus of echinoids of the upper cretaceous.—**Zippora Danin**: Gaseous content of the cenobia of *Rivularia polyotis* (J. Ag.) Hauck. The gases secreted in these cavities are similar to those formed in the corresponding cavities of brown and green algæ.

Official Publications Received

British

Journal of the Indian Institute of Science. Vol. 15A, Part 2: Chemical Examination of the Root-Bark of *Plumbago rosea*, Linn. By M. C. Tummin Katti and V. N. Patwardhan. Pp. 9-16. 8 annas. Vol. 15A, Part 3: Dilatometric Studies in Enzyme Action. Part 2: Contraction *Constants of Enzyme-Substrate Reactions.* By M. Sreenivasaya and H. B. Sreerangachar. Pp. 17-24. 12 annas. Vol. 15A, Part 4: Aryl Di- and Poly- Stibinic Acids; Distibinous Oxides and Distibino-Compounds. By Sohrab M. Mistry and Praphulla Chandra Guha. Pp. 25-40. 1 rupee. Vol. 15B, Part 2: Measurement of Power Factor and Loss in Dielectrics. By T. J. Mirchandani, G. Yoganandam, S. K. Roy and N. V. Narayanaswami. Pp. 17-32. 1.4 rupees. (Bangalore.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1932, Vol. 44, No. 5, June. Pp. 219-270 + xxxii. (London.)

Journal of the Chemical Society. June. Pp. v + 1641-1904 + viii. (London: Chemical Society.)

British Standards Institution. No. 458: British Standard Specification for Xyloles (Pure Xylole, 3° Xylole and 5° Xylole). Pp. 29. (London: British Standards Institution.) 2*s.* net.

School Buildings. By John Sargent and A. H. Seymour. Pp. 30. (London: National Union of Teachers.)

Proceedings of the Physical Society. Vol. 44, Part 4, No. 244, July 1. Pp. iv + 439-528. (London: Physical Society.) 7*s.* net.

Quarterly Journal of the Royal Meteorological Society. Vol. 58, No. 245, July. Pp. 217-320. 7*s.* 6*d.* No. 246: Report on the Phenological Observations in the British Isles from December 1930 to November 1931. By J. Edmund Clark, Ivan D. Margary, Richard Marshall and C. J. P. Cave. (No. 41.) Pp. 321-376. 8*s.* (London: Edward Stanford, Ltd.)

British Empire Cancer Campaign. Ninth Annual Report of the Grand Council, presented at the Meeting held at the House of Lords, 11.7.32. Pp. 209. (London.)

Proceedings of the Royal Society of Edinburgh, Session 1931-32. Vol. 52, Part 3, No. 14: The Fæcal Pellets of the Anomura. By Hilary B. Moore. Pp. 296-308 + 2 plates. 1*s.* 6*d.* Vol. 52, Part 3, No. 15: A Study of the Tyrosinase of Potato Tubers. By Dr. Ian M. Robertson. Pp. 309-314. 9*d.* (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Canada: Department of Mines: Geological Survey. Summary Report, 1931, Part C. (No. 2308.) Pp. ii + C93. Economic Geology Series, No. 10: Gold Occurrences of Canada; Summary Account. By H. C. Cooke and W. A. Johnston. (No. 2309.) Pp. iii + 61. 20 cents. (Ottawa: F. A. Acland.)

Annals of the (Mededelingen van het) Transvaal Museum. Vol. 14, Part 4. Pp. 251-430. (Pretoria.)

Proceedings of the Sugar Cane Investigation Committee. Vol. 4, Part 1, June. Pp. 61. (Trinidad: Imperial College of Tropical Agriculture.)

The Freshwater Biological Association of the British Empire. Report of the Council, 1932. Pp. 7. (Cambridge: J. T. Saunders, Hon. Sec., Christ's College.)

Harper Adams Agricultural College, Newport, Shropshire. Pig Feeding Report No. 1: The Work of the Harper Adams College *Pig Feeding* Experimental Station, 1926–31. Pp. 44. (Newport.) 1*s.*

Foreign

Beiträge zur Natur- und Kulturgeschichte Lithauens und angrenzenden Gebiete. Herausgegeben von Prof. Dr. E. Stechow. Vegetationsstudien auf lithauischen und ostpreussischen Hochmooren. Von Dr. H. Reimers und Dr. K. Huech. Pp. 409-494 + 12 Tafeln. Biologische und morphologische Notizen über den Kaukasuswisent. Von E. W. Pfizenmayer. Pp. 497-504 + 3 Tafeln. Über die einstige Hege des Wisent im Urwalde von Bialowies; Über einige Muriden aus Lithauen. Von Prof. Dr. E. Stechow. Pp. 505-510 + 1 Tafel. Archäologische Untersuchungen im Urwalde von Bialowies. Von Prof. Dr. A. Götze. Pp. 511-550 + 10 Tafeln. Über Wachstums- und Altersveränderungen am Skelett des Wisents. Von Dr. Walter Koch. Pp. 553-678 + 3 Tafeln. Vorwort und Inhaltsverzeichnis. Pp. viii + 1 Tafel. (München: Bayerische Akademie der Wissenschaft.)

Proceedings of the United States National Museum. Vol. 80, Art. 22: New West Indian Cerambycid Beetles. By W. S. Fisher. (No. 2922.) Pp. 93. (Washington, D.C.: Government Printing Office.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 141: Some Chewing Insects infesting Michigan Evergreens. By E. I. McDaniel. Pp. 54. Circular Bulletin No. 143: The Construction and Management of Air-Cooled Storages with Special Reference to Apples. By Roy E. Marshall. Pp. 43. Special Bulletin No. 221: Controlling the Codling Moth in Southwestern Michigan. By Franklin Sherman III. Pp. 31. Special Bulletin No. 223: Bald Rock Wheat. By E. E. Down and H. M. Brown. Pp. 19. Technical Bulletin No. 122: The Dissociation of *Salmonella pullorum* and related Species. By W. L. Mallman. Pp. 40. Technical Bulletin No. 123: The Diagnosis of *Brucella* Infection in Animals and Man by Rapid Macroscopic Agglutination. By I. F. Huddleson. Pp. 18. (East Lansing, Mich.)

Cornell University Agricultural Experiment Station. Bulletin 533: *A Statistical Analysis of the Results of Breeding High-Line and Low-Line Leghorns.* By D. R. Marble and G. O. Hall. Pp. 38. Bulletin 537: The Chemical Composition of the Muck Soils of New York. By B. D. Wilson and E. V. Staker. Pp. 25. Bulletin 538: Soil and Field-Crop Management for Cayuga County, New York, by A. F. Gustafson: Pastures, their Improvement and Management, by D. B. Johnstone-Wallace. Pp. 114. (Ithaca, N.Y.)

Catalogues

Important and Rare Books on Gardening and Agriculture (1801 to Recent Times), including Forestry, Fruit-Culture, Medical Botany, Tobacco, etc. (New Series, No. 20.) Pp. 164. (London: Wheldon and Wesley, Ltd.)

Diathermy Apparatus (Surgery and Treatment). (Publication No. F. 23.) Pp. 24. (London: Newton and Wright, Ltd.)

SATURDAY, AUGUST 13, 1932

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Racial Character and Criminal Responsibility

IT was evident from the moment of the arrest of Paul Gorguloff after the assassination in May last of the President of the French Republic, that the trial would be one in which the expert evidence of the alienist might be expected to have the last word. In the event, owing to the line taken by the prosecution, the case is likely to be of greater significance in relation to fields of scientific research other than morbid psychology. The crime was of a type with which the world has been only too familiar in the last half-century or so. The assassination on Sept. 10, 1898, of the ill-fated Empress Elizabeth of Austria, blameless and universally beloved, will mark for all time the futility and tragedy of such crimes, in which the choice of victim is determined solely by social pre-eminence and the assassin has no specific personal grievance, but is dominated by an overwhelming and violently perverted sense of social injustice, directed impartially against any and all in authority.

Nihilism is no longer in vogue as a mode of political expression. Its place has been taken by other ' isms ', which claim for themselves a more consistently grounded philosophy, but, it may be said incidentally, have a more far-reaching and devastating effect, even if their aim be ostensibly constructive. The individual who by assassinating the ruler of a country, usually not his own, seeks to pave the way to the regeneration of the world—Gorguloff at his trial acclaimed himself as an " apostle "—is now something of a political anachronism. The assessor of his criminality is no longer the statesman, nor the touchstone of his crime the stability of the social order. He has become merely a subject for the alienist.

A defence of insanity in a legal trial places the prosecution in a position of considerable embarrassment. Recent controversy in British medical jurisprudence has been an indication of the difficulties which are experienced in fixing the degree of criminal responsibility in such cases. For, it must be remembered, the legal issue is not insanity *per se*, but responsibility. When the crime is political the difficulties of arriving at the state of mind of the accused at the moment of the criminal act may be enormously increased by prejudice.

Political crime which goes to extremes is, fortunately, rare in Great Britain, and the common-sense view, somewhat phlegmatic, of the British public towards hyper-enthusiastic reformers, as well as the notoriously impartial attitude of judges, law officers,

and courts, have a modifying effect on the heat of political controversy. On the Continent, however, the temper of the public and the atmosphere of the courts, which, as representing the State, are vindicatory rather than judicial, contrive to imbue cases of political crime with a more vital quality in their relation to the everyday life of the average citizen; while the more aggressive methods of political extremists there have too often justified the apprehensions with which the logical consequences of their doctrines are regarded. Expressions of opinion, which in Great Britain would be thought the mere vapourings of a doctrinaire, in France or Spain, for example, will be accepted as a prelude to action of a corresponding violence.

If it is true logically, as well as legally, that it is impossible to indict a whole nation, it is scarcely less true that it cannot be confined to the limits of a generalisation on its psychic characters. Yet in the Dreyfus case, the condemnation of an officer suspected of betraying official secrets to a foreign power, which appeared to the world at large as more than probably a miscarriage of justice, was an almost instinctive reaction of virtually a whole people, which saw itself already defenceless and outmanœuvred, and the overwhelming victory of an enemy force *fait accompli*. A racial capacity for logic may, it seems, readily develop hysteria. On the other hand, Italy's realism grapples drastically with facts as they are. Its methods of attacking social and political problems leave no place for aspirations or theory, unless officially approved. Hence the secret society. In Germany an ideal of pan-Germanic sentiment, in which its youth is sedulously trained, is supreme, however parties may differ as to the best means of its attainment. Here are samples, taken not quite at random perhaps, but none the less significant, of the manner in which different peoples are dominated by psychic constitution in their reaction to a political crisis, and the attitude of mind with which they may be expected to view an act committed for political reasons and with a background of political theory, such as was the assassination of the French President.

It may seem that these speculations on the effect of racial character as a factor in politics have led us rather far from the function of the alienist as the assessor of criminal responsibility. This might be so, were it not for the argument put forward by the prosecution in the trial of Gorguloff.

As was to be expected, the defence entered a plea of insanity, and it is significant of the almost academic method of approach that its principal witness, Dr. Logre, made the admission, which might well have been damaging in certain contingencies, that he personally had not examined the accused. He maintained, however, that the report of Gorguloff's examination showed that he was a border-line case, neither completely responsible nor completely irresponsible. He summarised the mentality of the accused, in what was virtually a characterisation of a type, by saying that he would have certified him as showing " lack of the critical spirit and the sense of responsibility, tendency to paranoia and morbid ideas, megalomania, persecution mania, and the possession of an idea that he had a mission to fulfil, believing himself to be not the saviour of his country alone but of the whole world ". His colleagues, he said, had not taken into account the drama going on in the spirit of the accused man. Gorguloff, who had been consistently incoherent in his frequent interruptions throughout the trial, especially when evidence had been given of his actions as torturer and member of the Cheka at Rostoff, here accepted the doctor's interpretation of his mentality with emotion, declaring with sobs that the doctor understood his soul and that he could now die like an apostle. The last expert witness for the defence was more concise than Dr. Logre. The case, in his opinion, was simple: the prisoner undoubtedly suffered from paranoia, megalomania, and a persecution complex—a case in which one had to be on the look-out for tragedy.

It has seemed desirable to outline the defence out of its proper order so that the remarkable line taken by the prosecution's expert witnesses may be fully appreciated. It is to be noted that they, or at any rate the most important of them, Dr. Genil-Perrin, insisted that no interference or hint had been received from the defence. It is evident, however, that they had anticipated the defence, as, indeed, any expert was bound to do, and that their examination of Gorguloff was directed, perhaps almost unconsciously, to meeting the course it was presumed it would take by finding the basis of an argument which would be conclusive, in the eyes of the court, in proving his sanity.

The line of argument developed by Dr. Genil-Perrin was that Gorguloff was a native of the Caucasus, " a country where the people lived among myth and legend ", and belonged to a different and " perhaps ill-assimilated civilisation " ; while the atmosphere of terrorist Russia may have predisposed him to acts of violence. He was, therefore, to be regarded as responsible. In other words, the witness's contention was that in assessing the degree of responsibility in an apparently abnormal mentality, race and culture must be taken into account.

young child's usual creeping, and obviously suggestive of the walking of gorilla, chimpanzee, and orang utan, when these apes are on all fours and not trying to be bipedal. There is this difference, however, that these apes rest their fore weight on their knuckles, and that the orang rests its hind weight on the outer edge of its foot.

Hrdlička began to search for other examples of quadrupoid infants, and he has been gradually rewarded by finding 387 cases, 369 white and 18 coloured. He has also collected a number of references to this unusual mode of progression, but few of these seem to us to be of more than bibliographical interest, most of them being very vague in their description of what the actual movements were. Of Hrdlička's cases, 331 are more or less satisfactory, but the number is relatively small for the time given to collecting, and indicates that running about on all fours is not of frequent occurrence.

The phrase 'on all fours' is often colloquially applied to children levering themselves along the nursery floor on their hands and knees, or in some modification of creeping and crawling; but Hrdlička rightly restricts it to those cases where the hands and feet are pressed more or less flat on the ground, while the knees are off it. It is a kind of locomotion comparable to that of a bear or some other plantigrade mammal going on all fours. One must not, of course, press the conformity to the defined type too hard, for the phenomenon is a variable variation and has different degrees of expression. Thus the hands are occasionally flexed; in rare cases there may even be a use of the knuckles; or the anterior contact with the ground may be restricted to the fingers. Similarly, the part of the foot behind the toes may be off the ground, especially when the child is putting on speed. There are many oscillations within the variation; yet there are few, if any, of the photographs submitted that could be mistaken for a moment for the common 'hands and knees' progression. It is interesting to notice that the 'all fours' method may precede the 'hands and knees' method, or succeed it, or alternate with it; but if it occurs at all, it is usually the only (recorded) way of moving before the child begins to toddle.

The 'all fours' children are almost always vigorous in body and mind; they move with striking rapidity and show more than average power of balance; after becoming bipedal they may occasionally return to the quadrupedal method, which is for a while quicker than toddling; in a few cases the habit may be prolonged to the age of five years,

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Smithsonian Institution, Washington, 1

The question arises as to the nature of t
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must remain to some extent a matter
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gards it as an individual recapitulation of
human mode of progression, such as is s
gorilla, chimpanzee, and orang utan, with
differences already noted, or in baboons
monkeys, where the hands and feet are plant
more or less flat on the ground.

The difficulty is the relatively rare manifestat of the peculiarity, so far as we know, for its expression is certainly not part of a normal ontogenetic recapitulation of a phylogenetic stage. It seems to be casual. The author is disinclined to regard it as a reversion or atavism in the strict sense, that is, as due to the reactivation of a hereditary factor which is normally dormant. When one thinks of it, it is a far cry back to a plantigrade primate ancestry, and the 'all fours' method is itself, as we have mentioned, somewhat variable in its expression. The author concl
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defined predisposition to climb trees,
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ship, of which his body retains many
as has been indicated in detail by R.
ly and by F. Wood Jones. Also very
ar is the prehensility of the toes in many
g children, who will lift a pencil or the
with their toes to their hands or to their
outh. These are but examples of what is well
own. There is still much to be discovered in
gard to the way in which the past lives on in
le present.

Adsorption Data

The Sorption of Gases and Vapours by Solids. By Prof. J. W. McBain. (Twentieth-Century Chemistry, 4.) Pp. xii + 577. (London: George Routledge and Sons, Ltd., 1931.) 25*s.* net.

RECENTLY it has been stated that on the average a paper on adsorption appears every
.v in the year. Prof. J. W. McBain's volume is a
.iece of collection, codification, and classifi-
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(pp. 33-426), which is certainly
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plete, but also extremely interesting to read, as the author has from time to time inserted personal comments and criticism. It is, on the other hand, not so satisfactory if regarded as an introduction to the third section, which includes the theories of adsorption. The reviewer has found it very difficult 'to see the wood for the trees'. To take only two examples. We know with some degree of certainty that practically all cases of adsorption are accompanied by a penetration of the gas or vapour into the interior of the solid by processes which may include space-lattice diffusion, persorption through molecular sieves, intergranular diffusion and capillary penetration, and it is indeed to Prof. McBain himself that we are largely indebted for a proper appreciation of the importance of this phenomenon. Again, from the work of Dewar on the oxygen charcoal system, of Ostwald and Langmuir on the system $CaO - CO_2$, it was clear that at least two states of adsorption existed. The work of Benton and of Nikitin has revealed another state, the existence of which has been confirmed by the more recent work of H. S. Taylor and of Garner. These three types of adsorption, sometimes termed Van der Waals' adsorption, activated adsorption, and chemi-adsorption respectively, all exhibit their own peculiar characteristics, and examples of all three types can indeed occur in certain systems when taken over a sufficiently wide range of temperature. Whilst the actual facts are presented to the reader, a dissection of the data by Prof. McBain, or even an arrangement of the data in such a manner so as to exemplify those points, would provide a reader with a valuable introduction to the theoretical section.

In the theoretical section, the author subjects the hypothesis of adsorption in multimolecular layers to a somewhat detailed analysis, concluding that Langmuir's hypothesis of monomolecular adsorption is adequate to fit all the data which have been established with sufficient degree of certainty. The discussion on the more recent developments of Langmuir's original hypothesis, such as surface mobility and the necessity for energies of activation after 'primary' adsorption, is particularly interesting. More might have been included in the section on active patches and promoters, on the importance of lattice spacing as distinct from isolated atoms or configuration as factors in reaction at or with a surface.

The volume is full of most interesting information clearly presented, and can certainly be recommended to all those who are interested in the phenomena of sorption. ERIC K. RIDEAL.

Short Reviews

Bacteriological Control of Milk: a Practical Guide for Media Preparation and Milk Testing. By A. G. House. Pp. vii + 59. (Reading: The National Institute for Research in Dairying, 1931.) 3*s.* 6*d.*

THIS practical little book contains much useful information on routine bacteriological testing of milk samples. The section on sterilisation is admirable, though it is rather surprising that electrical apparatus, particularly for hot air sterilisation, is not mentioned. Media-making is an art in which precise details always vary according to the experience of the particular technician practising it. To the present reviewer, Mr. House's technique seems in several directions over-elaborate. To mention only one point: in filling media into test tubes, pouring through a small funnel is simpler than the use of a previously sterilised syphon apparatus.

The obsolete titration method of standardising media is described, as well as the *p*H method. It is stated that media can be sufficiently cleared by steaming, but where final sterilisation is done in the autoclave there will be further precipitation, and a preliminary autoclaving is therefore better practice. However, no two technicians will ever agree on such points, or be induced to depart from their favourite methods.

The directions for the actual testing and for the collection and transmission of samples are clearly given. Lactose bile-salt cultures should surely be incubated for three days rather than 48 hours before being regarded as 'negative'. Mr. House very properly relegates the reductase test to its true position as a rough sorting test only. Useful lists of apparatus and equipment are given in an appendix.

R. F. H.

The Keys of Power: a Study of Indian Ritual and Belief. By J. Abbott. Pp. xi + 560. (London: Methuen and Co., Ltd., 1932.) 21*s.* net.

MR. ABBOTT is concerned neither with the religion of the Prophet nor with the animistic concepts of Hinduism, but deals only with the far older underlying belief in a universal supernatural cosmic power which lies behind phenomena and has determined the ritual and practice of the natives of India from time immemorial. Unfortunately, the conservatism of India, which has preserved this ritual unchanged for so long, is not now operative in every department of human activity. Mr. Abbott has to record that the traditional customs, for example, of agriculture, are rapidly passing away. He himself in the last decade has witnessed, in the Deccan, customs discarded by the younger generation and left to the older to preserve; while in Gujerat and Sind the changes have been great. The anthropologist, therefore, will be all the more grateful to him for his assiduity in collecting the large amount of detailed information recorded in this book relating to the manifestation of 'power', or 'mana', as accepted by Mahommedan and Hindu alike, and the ritual which this belief entails in every depart-

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B. C.

Insect Pests of Farm, Garden and Orchard. By Prof. E. Dwight Sanderson. Third edition, revised and enlarged by Prof. L. M. Peairs. Pp. vii + 568. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 13*s.* net.

WE welcome the appearance of the third edition of this standard book, which has justly enjoyed popularity as being one of the best manuals dealing with North American agricultural pests. It is similar in general arrangement to its forerunners and contains about the same amount of subject matter, but, owing to the larger page employed, the total number of pages is considerably reduced. Only a few of the articles written by Prof. Dwight Sanderson in the first edition remain more or less unaltered. For the rest, the book has been largely rewritten by Prof. L. M. Peairs, who has embodied the results of recent investigations and included a number of new illustrations. As stated in the preface, the edition is properly that of Prof. Peairs, although the name of the original author is retained.

The Story of Science. By David Dietz. Pp. xvii + 387 + 31 plates. (London: George Allen Unwin, Ltd., 1932.) 10*s.* 6*d.* net.

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ghteen years ago, then, and indeed for some
later, rickets was regarded by many of the
best authorities in Europe as a chronic infective disease of which the infective agent was unidentified. It was called on the Continent the 'English disease' because it was first described in England and because of its abundance in our smoky cities. The disease consists most prominently in the failure of the calcifying process that gives hardness and strength to the bones and to the teeth, and the rickety child is stunted, deformed and enfeebled in various degrees. Before the War it was estimated that in our cities at least one child in every three had obvious signs of rickets. Dr. Mellanby discovered, by laborious experimental work, that rickets is simply a deficiency disease due to the lack in the food of a particular constituent, now called vitamin D. The proper supply of this prevented rickets or rapidly cured rickets already present. Familiar now as this is, even to laymen, it was greeted at first and for some years by much scepticism in many medical circles.

This discovery has led to a remarkable series of developments. It had been found that sunshine upon the body also prevented or cured rickets, that it was the short ultra-violet rays that had this action, and that it could also be produced by
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pertinent metaphor for Dr. Rosenheim at the National Institute for Medical Research) found with Mr. T. A. Webster that it was not cholesterol itself that gave this result but a related substance, present with it in much smaller quantities. This, after exchange of results and ideas with Prof. A. Windaus of Göttingen, was identified as a sterol called ergosterol, previously known only as the characteristic sterol of certain fungi and of yeast.

Now the problem became one for intensive study by physicists, organic chemists and biologists working in intimate collaboration. A team of this kind, working under the general leadership of Dr. R. B. Bourdillon at the National Institute for Medical Research, obtained a crystalline substance of very high antirachitic activity by the physical process of distillation in a high vacuum; and another team under Prof. Windaus, in Germany, obtained a very similar substance by a selective chemical reaction. Both of these, however, proved to be compounds of the vitamin with inert substances; and Dr. R. K. Callow, of the National Institute group, found a method of separating the vitamin from either as a crystalline ester, from which the pure vitamin can be liberated. It proves to be itself a sterol, differing from the parent ergosterol only in a detail of the structural arrangement of its atoms, and it has been given the chemical name 'calciferol'. In pure form this has almost incredible biological potency. A single ounce of it would suffice to give a full daily ration for a million growing children.

It is to be noted that this devotion of physicists and chemists to a medical problem has done more than assist medical knowledge. It has yielded additions to both physical and chemical methods. A new form of photoelectric microphotometer which multiplied five-fold the speed of observations was produced in its course, together with a new type of spectrograph. Important new contributions have been made and are still being made to our knowledge of the pure chemistry of the group of sterol compounds. In deciding between alternative possibilities of structure for these complex molecules, the chemist is becoming more and more dependent on the physicist for measurements made by the methods of X-ray analysis.

Now this progressive work, interesting as it is, is not only a clever physico-chemical exploration of academic interest. The results of this intensive laboratory work take on at once a direct bearing upon the practical needs of the community. Accurate knowledge of the vitamin allows adequate standardisation of its amount in different foodstuffs, in terms of a fixed standard of reference. Its artificial production, moreover, brings into action, or should bring into action, the medical administrator, who should be concerned to see that so long as social or economic factors maintain, as they do, an effective shortage of the natural sources of the vitamin among our city populations, a supply

of it by means of the new methods we now have at command shall be made available for every growing child and every child-bearing mother in the country.

There still remains for study the attractive physico-chemical problem of how it is exactly that this calciferol molecule exerts its special influence upon the living cells of the intestinal walls and exactly why, without it, they cannot do their work of effecting the passage of calcium salts into the blood from the food but not back again. Of this we now know almost nothing. Here our task is to attempt further steps towards better knowledge of the mysterious microcosm of the living cell substance.

Other fascinating vistas are in sight. Only in the last few weeks workers in the physico-chemical laboratory at Cambridge have found some evidence that the action of particular wave-lengths of light in developing vitamin D from its precursor substance may not be, as we had been thinking, an isolated phenomenon. They have obtained some indications that, just as for this, so in the case of two other vitamins—each in its own way indispensable for animal life—particular wave-lengths of light may produce the vitamin from its precursor while other wave-lengths close to them destroy it. What we know already of the chemistry of the vitamins having these special relationships to light shows that they belong to widely different types of chemical compounds. If the indications just given should be confirmed, it will seem to be, so to speak, more than a mere coincidence that in two or three different directions at least the animal cell has come to be vitally dependent upon different individual chemical substances, of which each has these remarkable photochemical properties. We should have to consider that we have here perhaps taken our first step towards knowledge of a phase of evolutionary development that has not been dreamed of hitherto, a development made manifest in a highly specialised and detailed adaptation of living matter to its age-long environment of light.

In quite another direction, the growing demands of medical research for intensive physico-chemical studies may be illustrated. Among the varieties of parasitic life that infest the animal body, I mentioned the so-called viruses that cause devastating diseases in man, in animals, and in plants. The loss they cause in life and in money has a magnitude almost beyond calculation. They cause smallpox, measles, infantile paralysis, and many other diseases in man. They cause foot-and-mouth disease of cattle, swine fever, fowl-pox, and other devastating plagues in animals. They cause ruinous diseases in vegetable crops of many kinds, from potatoes in Great Britain to bananas in the tropics. They are called 'viruses' at present because that commits us to no decision as to their nature. What do we know about them ? In a fluid containing them they can be shown to be freely suspended and particulate bodies, for the fluid can be freed from them by rapidly spinning it in a tube so that the particles are driven to one end of it. The bacteria themselves vary widely in size as animals do. None of them can be seen with the unaided eye, and taking the largest as enlarged to the size of a horse the smallest would then be represented by a mouse—and would be near the extreme limit of our highest powers of direct microscopic vision. The viruses are so small, however, that they pass through porcelain filters that retain all bacteria, and they are just upon or beyond the border-line of direct vision by ordinary microscopic means.

Here again medical research has had to call for the intensive application of new physical methods of study. By using the shorter wave-lengths of ultra-violet light the limits of clear microscopic vision can be extended, though this involves using quartz instead of glass throughout the optical apparatus, and obtaining photographic images instead of using direct vision by the eye. It is desirable to photograph the virus bodies in their natural state undisturbed by chemical agents or by stains which by coating their surface alter their apparent size. These methods are already being successfully applied at the National Institute for Medical Research by Mr. J. E. Barnard, who has been foremost in developing them. Another physical problem has been to devise suitable filters with apertures of known size and uniformity so that the different viruses may be graded in order of magnitude and the work of separating them in the laboratory made constant and accurate. This problem has been largely solved already by Dr. W. J. Elford, also at the National Institute, who has found how to produce accurately graded and uniform filters by making collodion films under precisely controlled conditions.

Many of the known viruses have already been arranged in an order of size, and the results gained by optical and filtering methods, which are constant, agree closely where they can be compared. They show that the viruses vary in size nearly as widely as the bacteria do. The largest are close in size to the smallest bacteria, and they descend to the virus of foot-and-mouth disease, of which the particles are little larger than the colloidal aggregates of oxyhæmoglobin in solution. There is probably not room in each particle for more than two or three hundred protein molecules. They can be present in immense number, and yet very few of them are enough to carry full potency. The fluid from a case of foot-and-mouth disease can be diluted ten million times and yet be potent to reproduce the disease.

There are many reasons for considering the viruses to be the smallest forms of life and for allowing them to be living organisms. But there are many unsolved difficulties here. The particles are far smaller than the simplest living cells which have hitherto been regarded as the smallest organisations of living matter endowed with specific character and the power of self-production. It is not certain that a virus can multiply outside a living animal or plant cell : inside it they may multiply with such rapidity as to make it tempting to think that the new particles are being formed not by the growth and a doubling subdivision of their

own substance, but directly, and by some more rapid transformation of matter, out of the substance itself of the living cell containing them. In other words, it may perhaps be as true to say that the disease causes the virus as that the virus causes the disease.

Here again we notice how great is the intellectual interest offered to the physico-chemical student, quite apart from any incentive given by the gigantic practical benefits that will certainly be the reward of successful work in this field. It may be that in the study of these minute forms we are destined to find new clues to some of the most fundamental properties of living matter, and to express them in terms of physics and chemistry. It is perhaps just as likely that we may find ourselves able instead only to express physics and chemistry at this point in terms of life.

It is obviously most urgently desirable that we should increase our knowledge of these tiny forms and the laws of their behaviour as rapidly and fully as possible, if only with the direct utilitarian object of protecting the life and property they attack upon such an immense scale. We have to remember, too, that beyond a doubt some forms at least of malignant disease can be propagated by minute particles of matter which have all the known characters of the viruses. That being so, it is hard not to believe that the right clue to the problem of cancer lies here, and it is in fact being devotedly pursued from that point of view.

I might give many other examples of the great refinements now attained in many directions of biological and medical work. For study of the electrical changes in rapid muscular movement, the physiologist Einthoven introduced the string galvanometer which has been so useful in the hands of Sir Thomas Lewis and others in recording and analysing the successive events in the beat of the heart, normal or disordered. This instrument has passed as a contribution from biology to the regular uses of the physical laboratory. New devices of amplification by the physicists, on the other hand, have allowed Dr. Matthews at Cambridge to follow and measure the curve of electric change due to the passage of an impulse along a single nerve fibre, while Dr. E. D. Adrian there obtains an audible record by a loud-speaker of the impulse, for example, which passes along the optic nerve of a fish when a brief shadow flits across its retina. Prof. A. V. Hill follows the course of the heat changes due to the train of transient and minute chemical changes in nerve fibres that propagate the nervous impulse and measures them with an accuracy expressed in millionths of a temperature degree. The biologist, if given two samples of crystallised egg albumen from the eggs of a duck and hen respectively, can tell, by means of a biological test, which of them comes from which bird with great rapidity and certainty, though the detection depends on a subtle difference of molecular pattern far beyond the reach of any analysis by the chemist. Dr. Todd, at the National Institute at Hampstead, again, has shown that the interactions of the blood between fowl and fowl can be so used as to enable the biologist if he desires it to identify any given hen and its family from any other hen in the world. No organic chemist has ever dreamed of performing in such subtlety as that.

Medical progress, however, is greatly hampered by various circumstances that keep from its services many of the able men who are best fitted to enjoy giving their life-work to advancing it.

One of the most serious of these is the unfortunate and harmful tendency both in the schools and in the universities to segregate physicists and chemists on one hand from biologists on the other. At the schools this is largely the result of the scholarship system. It is found easier to cram clever boys along narrow specialist lines in physics and chemistry for scholarships at the universities, while the universities have never taken effective action so to use the scholarship system as to secure a well-balanced scientific education for scholarship candidates. The result is twofold. The cleverer boys are diverted from biology, while the biologists, if any, must give up proper training in the physical subjects and themselves specialise narrowly if they are to have any chance of scholarship success. The system of university examinations at both Oxford and Cambridge encourages still further this segregation of the sciences, and at Cambridge changes in regulations during the last twenty years have made the position worse rather than better. These are not only personal views drawn from my own experience; the same opinions have been strongly expressed by Lord Chelmsford's Committee, appointed in 1930 by the Prime Minister to consider the obstacles which stand in the way of the education and supply of biologists for work in Great Britain and overseas.*

I must not enter further upon this educational question now. I want only to urge here that the general cause of medical research suffers greatly from the present wide and unnecessary divorce, during the earliest stages of education and onwards, between those taught on the physical side and those upon the biological side. It is wholly indefensible on any ground that schoolboys and undergraduates who have special aptitudes for physical inquiry should be confined by a faulty system to the study of non-living matter only. The problems of the living cell are at least as attractive to a keen mind as those of non-living matter, and they demand perhaps greater rather than less manipulative and analytical skill, because of the instability of the living substance that is studied.

Medicine has always been the mother of sciences, and we may remember that it was from the body of medicine, namely from the schools of physiology, and not from schools of organic chemistry, that biochemistry was born and developed as an organised university discipline. It has been found indeed as the result of experience that the man trained narrowly in organic chemistry does not in general make the best biochemist. Without earlier acquaintance with the problems of living things, he

* Report of the Committee upon Education and Supply of Biologists. H.M. Stationery Office Publications, 63-75, 1932. Price 1s.

is less likely to break new ground than the biologist starting far behind him in purely chemical equipment. There is pressing need now for a parallel development of bio-physics, not necessarily, or even desirably, as a separate discipline, but by a breaking down of the present artificial educational barriers between physics and physiology, barriers so unworthy of the Greek spirit of which those very names remind us.

I must not stay to speak of still another set of conditions that handicap medical progress. Of those biologists who pass on to hospital work and the study of disease as such, many who are among the fittest to make new knowledge in the sphere of clinical medicine are tempted to turn aside from the arduous path of new investigation, either because of the absorbing human interest of professional work or again because of their financial needs or desires.

The mastery over non-living matter which physical science has given us has transformed all the conditions of human life within a century, but the conveniences offered by improved transport and improved communications have brought only superficial changes, and it is doubtful whether they have done on the whole greater service or disservice to the happiness and well-being of mankind. Our improved powers of producing wealth, as the whole world is now observing, seem already to have outrun lamentably our powers either of wisely using or even of retaining it. It is better mastery over living matter, and the improvement of the bodily and mental powers of man, that are needed for the real betterment and enrichment of the race. By powers of a kind that we are already in process of gaining by medical research we may hope to transform human life in ways almost unimagined now and to make a new world indeed.

Without entering into dreams of the far future we know that here and now the campaign of medical research is improving our estate. Its progress and success have immediate interest for all of us and the highest claims upon the goodwill of all mankind. It is a campaign to diminish pain, to lessen the waste of human effort and human life, and to enrich and enlarge the powers of the human body and mind.

York Meeting of the British Association

THE full programme of the York meeting of the British Association is approaching completion, and should be in the hands of members very shortly. A change of practice has been instituted with the view of economy and greater convenience. The "Programme and Daily Timetable" will embody the usual features both of the Association's list of transactions and of the so-called local programme formerly issued by the authorities at the place of meeting. Between these two publications there was always a measure of overlapping; moreover, the local programme was never in the hands of members until their arrival at the meeting. Now, following the practice initiated at last year's centenary meeting, when the whole organisation was centred at Burlington House, it becomes possible to place fuller advance information in the hands of members whose intention to attend, and postal addresses, are known.

Another and still more important change of practice with the same objects is initiated this year. It had become the custom, as is well known, for local committees to prepare handbooks for the successive places of meeting. Some of these have become standard reference-books of material value; on the other hand, the series followed no definite plan, and these books, again, were issued only at the meeting, and were sometimes very costly to produce. It is known that they did not always receive from members the attention they deserved: there is a case on record of a copy of the local handbook being seen on a second-hand bookstall in the place of meeting almost immediately after its issue. For the present year, a short "Scientific Survey of York and District" has been prepared by recognised authorities through the London office, with the collaboration of the appropriate sectional officers and the York executive. This also will be issued, so far as possible, to members in advance, and they will thus have the opportunity of priming themselves with information about the locality before they visit it. It is intended afterwards to include this "Survey" in the Annual Report, and if the present issue is found to form a satisfactory model, there will gradually accumulate, as the Association meets in successive centres, a systematic series of local scientific studies.

In these directions, at least, the Association has travelled far from the practice of twenty years ago, when the meeting was announced by a single leaflet, and members were left to find all other information at the meeting itself. Certainly the Association has become more businesslike (if the epithet may be permitted) in the formulation and announcement of its programmes. The main lines of the sectional transactions are laid down at the joint meeting of the organising sectional committees in January. The value of this meeting, which was initiated at the instance of the former general treasurer, the late Dr. E. H. Griffiths, has been, from the point of view of administration, immense, and it is believed to be the general opinion that it offers a most useful occasion for the really hard labourers in the Association's vineyard to keep in personal touch during the interval between the annual meetings.

As a result, the principal features of the meeting were known in broad outline when the "Preliminary Programme" was issued and noticed in NATURE for April 30, p. 642. Not many important corrections are made. The title of Lord Rothschild's presidential address to Section D (Zoology), not then announced, is now known to be "The Pioneer Work of the Systematist". The evening discourses by Sir Arthur Hill and Mr. C. C. Paterson have been transferred from the Exhibition Hall, which is found unsuitable for lanterns and demonstrations, to the less commodious but more

intimate Co-operative Hall, where, to obviate overcrowding, special tickets will be required (an unusual practice, which members are asked to note). The discussion on the university movement in Yorkshire, originally announced provisionally in Section L (Education), will not take place. For the rest, the full programme in no way falls below its predecessors in general interest. As compared with the York meetings of 1881 and 1906 (and indeed with later meetings) there is to be observed the widening of the tendency of sections to lay out their programmes and group their communications under definite broad headings. This is a movement appreciated by the informed public which it is one of the functions of the Association to address: the method gives a clear view, from year to year, of directions in which the main lines of scientific advancement are being laid down; and if the Association should be tending to leave the highly specialised individual communication to other more specialised media (and probably, on balance, there is such a tendency), the meetings should not on that account become less valuable to scientific workers. As occasions for personal contacts, these meetings are unique. To take a single illustration from the present programme, it is difficult to imagine another organisation which would give opportunity for a joint discussion of common problems between physicists and psychologists.

In the previous article on the York meeting in these pages, it was stated that many points of interest in the neighbourhood would be visited, and that no locality is richer in them. The full programme bears out this statement. In York itself there are all the antiquarian interests of the city. There are the cocoa and chocolate works of Messrs. Rowntree and Messrs. Terry, at both of which special receptions are being arranged. There are the museum, the carriage works, and the signalling school of the London and North Eastern Railway, the scientific instrument works of Messrs. Cooke, Troughton and Sims, and glass, aircraft, electrical, and other works. Taking a radius from York to the east coast, Hull, Leeds, and the Pennines, there are geological, botanical, zoological, archæological, industrial, and educational interests of the widest variety, of which the various sections which arrange their own excursions will take full advantage. The general excursions, mainly, as usual, on the Saturday, will combine railway and road travel in a manner not without significance when these methods of transport are elsewhere so strongly in opposition; there will also be occasions for relaxation on the River Ouse.

It might have been feared—indeed, it was feared—that the difficulties of the present time might react unfavourably on the attendance at the meeting. It is never known until the meeting itself what amount of local support by way of membership will be forthcoming: it is to be hoped that it will be ample at York. But so far as concerns the attendance of visiting members, as registered from day to day in the London office, there is no evidence of any enforced diminution of interest.

Lastly, these same difficulties, as suggested at the beginning of this article, have dictated economy in the working of the meeting. Traditions expensive to maintain had been handed on from one locality which entertained the Association to the next. The Council was instructed by the General Committee at the centenary meeting last year to review the cost of meetings falling upon local funds, and to suggest measures for its reduction. This has been done. The steps taken in cooperation with the York executive will not affect the Association's own funds in the direction of saving—they may, indeed, have a contrary result. But they will render the Association this year, and, it is to be hoped, in future, a less exacting guest than it used to be, and that without any diminution in the scientific value of its proceedings.

Obituary

SIR RICHARD THRELFALL, G.B.E., F.R.S.

NO one who knew Threlfall is likely to forget him: his robust personality, his bonhomie, his humour, his gift of vivid expression, his energy, his driving force, his power of telling a good story and of making a good speech, together with his massive frame, made an impression not easily effaced. Those who knew him most intimately knew that besides all this he was the staunchest and most helpful of friends, one on whose help they could rely in good times or bad, and whose death has taken from them a prop on which they had often leaned.

Threlfall was born at Hollowforth, a village near Preston, on Aug. 14, 1861, and in due time went to Clifton. Here his tastes soon became apparent; explosives were his first love, and legends about his adventures in practical chemistry still float about; one of these is that he conceived the idea of felling trees by the aid of dynamite and tried it on a young fir tree just outside the school, with the result that the tree was shot through the window of the school laboratory. Once when he was working at home during the Easter holidays, in a small laboratory which his father had fitted up, he had an explosion which blew off the third and little finger of his left hand and a good deal of the hand at the back of them, as well as the top joints of the right thumb and index finger. It was characteristic of him that before being driven into Preston to have his wounds dressed, he asked his mother to get a piece of wood and put it between his teeth so as to keep his mouth open. He said if he did get lockjaw he was not going to be starved to death as well. In spite of the loss of half his fingers he became one of the best manipulators and glass-blowers of his time, and wrote a book on laboratory arts. He was in the Rugby XV. at Clifton, and also shot for the School.

He left Clifton in 1880 and entered Caius College,

Cambridge, where he had won an entrance scholarship. Among the scholars of Caius in his time were many who attained great distinction, including Sir Charles Sherrington; the regius professor of civil law at Cambridge; and the Master of Emmanuel College. He took a 1st class in Part I. of the Natural Sciences Tripos in 1882, and again he was in distinguished company, for with him were Adami, Bateson, H. H. Head, Harker, Harmer, and Shipley, who all, like himself, became fellows of the Royal Society. Between the first and second parts of the Tripos he spent a semester at the University of Strassburg and worked under Profs. Fittig and Kundt. It was about this time that he constructed an automatic microtome. The history of this discovery is given in *Biological Reviews* of October 1930.

In 1884, Threlfall took a first-class in Part II. of the Natural Sciences Tripos. He was very prominent in undergraduate life, and played twice in the Rugby XV. against Oxford. In those days a 'blue' was not given in Cambridge for Rugby football, though it was in Oxford. The Rugby team was naturally up in arms, and said that if the 'blue' was not given to them they would take it for themselves. This brought all the wigs on the green, and in 1885 a meeting to which all members of the University were admitted was held at the rooms of the Union Society. The room was so crowded for some time before the proceedings began that when Threlfall, on whom the hopes of the Rugby supporters rested, arrived, he could not get beyond the crowd at the back of the hall, and had to be held up by some friends while he made his speech. The speakers before him delivered carefully prepared speeches which smelt very much of the lamp and left the audience quite cold. When he got up and jerked out from his uncomfortable stance one short sentence after another, full of good sense, good humour, and good jokes, he soon had the house rocking with laughter, and put the issue beyond doubt. I never heard a speech which had so much influence on the division. About this time he was Hercules in the "Birds" of Aristophanes, the second Greek play produced at Cambridge, and certainly looked the part.

Threlfall had worked at the Cavendish Laboratory while an undergraduate, and after taking his degree began systematic research work. He and I collaborated in some investigations, and I soon realised his quite exceptional skill as an experimenter. He was a demonstrator in the Laboratory for a short time, but left Cambridge in 1886 to take up the professorship of physics in the University of Sydney. When he arrived at the University and asked where the Physical Laboratory was, he was told there was no laboratory. Then he said he was going back to England, as he was not going to be a professor of physics without a laboratory; so they took him over the building and showed him a room here and another room there which might perhaps be spared to make the laboratory. When he said he was not going to have a laboratory of that kind, they offered to try to get the funds from the Government, but for a long time nothing materialised.

Threlfall had in the meantime become very friendly with the Prime Minister, and kept pressing upon him the claims of the laboratory, without any immediate result. One night, however, the Prime Minister came up to him at the club and said, "Dick, I have done the square thing by you at last. I've put your laboratory on the estimates. We've just been beaten on a division, and are resigning to-morrow, so that the other fellows will have to pay." The other fellows did pay, and Threlfall got a laboratory which at the time it was completed was at least as good as any in the world.

He had many amusing experiences in Australia. Once when he and the professor of geology were travelling together, they were surprised, when they arrived at a small town, to be welcomed by a band which struck up "See the conquering hero comes". The geologist said, the people here have evidently got some mine they want to boom, and are doing this to induce me to give them a good report. This seemed reasonable, but when they got to close quarters, it turned out that the people had mistaken Threlfall for Donald Dinnie, a famous Scotch athlete, who for many years had been the 'star' performer at Highland gatherings and could 'toss the caber' farther than anyone else had ever tossed it, and was at this time touring New South Wales. The geologist asked who they thought he was, and they said they thought he was the man who went round with the hat after the performance.

As soon as the laboratory was finished, Threlfall began to experiment, and many important researches by himself, his colleagues, and pupils were made during his tenure of the professorship. I hope at another time to give a detailed account of his contributions to physics, but I shall now confine myself to personal reminiscences. I may mention here, however, his experiments made on quite an engineering scale on the velocity of transmission of violent explosions through sea-water, and the work he did as chairman of the N.S.W. Royal Commission on the causes of the spontaneous combustion of coal in ships.

In addition to his more conventional duties, Threlfall played in the Rugby XV. of the University of Sydney.

Threlfall returned to England in 1899 and joined the well-known chemical manufacturing firm of Albright and Wilson at Oldbury, near Birmingham, the largest producers of phosphorus in England. The knowledge of phosphorus and its properties which Threlfall acquired at Oldbury were of vital importance to the country when War broke out. In 1905 he was elected an honorary fellow of Caius College, on the same day as Sir Charles Sherrington. He had been elected a fellow of the Royal Society in 1899.

Threlfall's qualities first found opportunities for their full development during the War. He threw himself with the greatest ardour into the work of applying chemistry to the needs of the Army, Navy, and Air Force. His qualifications for this were unique; he knew chemistry from the point of view of the manufacturer as well as of the professor, and

he had at the works at Oldbury great facilities for carrying out experiments on a large scale with the least possible delay. His powers of work, his ability to get results quickly, his energy and enthusiasm were quite extraordinary. He served on the Board of Invention and Research under Lord Fisher, on the Advisory Council for Scientific and Industrial Research, on the Trench Warfare Committee, and devoted practically all his time to work for the nation. I was on the Central Committee of the Board of Invention and know what he did for that Board alone. The committee met every week, and more often than not we had a report from him on some question that we had asked him to investigate, or gave him a new problem on which we wished for a report. His development of smoke screen and the tracer bullet were of vital importance in the War. For these services he was made K.B.E. in 1917 and G.B.E. in 1927, and never were these honours better earned.

After the War, Threlfall continued to spend a very large amount of time and work on the affairs of the Department of Scientific and Industrial Research, of which his great friend Sir William McCormack was chairman. He succeeded Sir George Beilby as chairman of the Fuel Research Board, and in 1919 went on a mission for the department to Japan. He also, after the War, spent a good deal of time and money on experiments on the effect of great pressure on carbon, as Moissan claimed to have produced diamonds in this way. Sir Charles Parsons was also about this time working by a method of his own on the same subject; neither were successful in producing diamonds, and they came independently to the conclusion, which I believe is now generally accepted, that Moissan was mistaken in the interpretation of his results. Threlfall also took up again a research which he had commenced when in Australia, that of measuring the variation of gravity at different places by means of a quartz torsion-balance.

Threlfall's published papers, good as they are, give a very inadequate idea of the amount or importance of his work, the most important part of which was done for the War or for the application of science to industry. This was known to few, and no account of it appeared in scientific papers; it is to be hoped that steps will be taken to keep it in remembrance.

He was nearly as keen about his amusements as about his work; he was fond of shooting and fishing, and was a good shot with both gun and rifle and an excellent fisherman. He was also the most sociable and 'clubbable' of men: he thoroughly enjoyed the meetings of the Royal Society Club, the Old Boys' dinners at Caius College, the Cavendish Laboratory dinner, or a dinner with a friend or two at the Athenæum; he enjoyed the dinner itself as well as the company. He was an excellent after-dinner speaker; his strong personality came out in this as in everything he did, and his speeches had a freshness and vigour all his own.

In April 1930 he had a serious illness, and though he recovered sufficiently to get about again, his health gradually declined, and on July 10 he died at his house in Edgbaston. He married in 1890, when he was professor at the University of Sydney, Evelyn Agnes, daughter of John Forster Baird of Bowmont Hill, Northumberland. Lady Threlfall died in 1929, leaving four sons and two daughters.

J. J. T.

I FIRST met Sir Richard Threlfall during the War, when he came to witness trials of his phosphorus smoke bombs. During the last year of the War I was in close touch with him, as he was busily engaged on other experimental work of importance to the Air Force, and frequently visited Col. Bertram Hopkinson, who was then in charge of experimental and research work for the Air Force. He was a great friend of Bertram Hopkinson; he had also been an intimate friend of his father, John Hopkinson. He often spoke to me about them in later years, and evidently held them in affectionate memory.

The particular work of Threlfall's with which I was then officially connected exhibited all his great powers of experimental skill, resource, and persistence. His persistence in research work was one of Threlfall's most marked characteristics. He never knew when he was beaten; he hated to acknowledge defeat in the laboratory. From a commercial point of view perhaps this was occasionally a fault, but on balance it must have paid hand over fist. When engaged on a problem, he would work long hours at night in his laboratory at home, tireless in the pursuit of his end. A remark in his paper on "The Electrolysis of Molten Zinc Chloride" (*J. Soc. Chem. Ind.*, July 1929) indicates his constant attitude to research. After referring to the formidable experimental difficulties he would have to encounter, he says, "However, in the end I decided that such difficulties as might arise could probably be overcome by steady work and engineering". They were.

Threlfall afterwards referred to this work as his most complete and finished investigation. It occupied, on and off, a period of eleven years, but unfortunately its commercial application was first prevented by the War, and afterwards rendered inadvisable by reason of other developments. However, this commercial failure had its bright side for other people, for it set him free to publish an account of the work on the occasion of the award to him of the Gold Medal of the Society of Chemical Industry in 1929. The account is necessarily brief; but it is written clearly and forcefully, and gives the reader a good idea of the magnitude of the problem, and of the skill and wide knowledge of the investigator.

The details of most of Threlfall's industrial work must necessarily remain confidential, but a brief reference to the chief items will indicate its scope. In addition to his researches on the electrolysis of fused zinc chloride, he worked out processes for the electro-chemical production of sodium chlorate, and ammonium persulphate, which were successfully operated on a large scale. He was also responsible for the substantial improvement of electric furnaces for the production of white phosphorus,

and for the erection of a station at Oldbury for the generation of electricity on a large scale from gas-engines. In the course of some of this work he was led to investigate the flow of gases in pipes, an account of which he afterwards published. He also devised a characteristic method for determining the efficiency of electric generators by air calorimetry, which gave rise to considerable discussion and interest among electrical engineers at the time (1903). His remaining industrial work included the development of processes for the manufacture of carbon tetrachloride and carbon disulphide, the production of ferro-chrome, and of some of the rare metals.

In my view, which I feel sure will be shared by all who knew something of his work, Threlfall was one of the greatest of electro-chemists. It was a subject which exercised to the full his profound knowledge of physics, his practical acumen, and, on the industrial scale, his engineering instincts. It is unfortunate that he was never able to publish a book on the subject, for his great experience and firm grasp of the subject would have certainly provided a strong impulse for further scientific research, especially in the rather neglected field of the electrochemistry of fused salts. Published scientific knowledge on this subject is meagre compared with knowledge hidden away in the electro-chemical industry, and the industrial electro-chemist must derive little benefit from current scientific literature. Some remarks of Threlfall's in an address to the Birmingham Section of the Institution of Electrical Engineers in 1905 are worth quoting. "The most pressing want at the moment among laboratory electro-chemists is a sense of humour in those who contribute accounts of their work to the various journals. Many of these papers appear to have been written with the idea that people interested in the subject enjoy reading for its own sake, and actually prefer fifty pages to five. . . . It is a thousand pities that the subject of electro-chemistry owes so little to French chemists—had it been otherwise, we should no doubt have had a standard of exposition which would have reduced the volume of the literature in the ratio of, say, ten to one." Possibly some may think that these remarks are true to-day, and that they have an even wider application.

The War gave Threlfall an opportunity of giving his great knowledge and experience to his country, and incidentally benefited him by widening his interests and giving him greater scope for his powers. In his own words, he was beginning in 1914 to settle down to the normal life of a successful business man in the Midlands, his only close touch with the scientific world being through the Royal Society, and its Dining Club, at the meetings of which he was a constant attendant. The War changed all that without bringing him the sorrows of a parent, for three sons, after long war service, all returned safely. Sir J. J. Thomson has already alluded to his valuable work for the fighting services; I need only add, as a matter worthy of special record, that he was the first to suggest the use of helium in balloons and airships, and expressed the opinion in 1915 that sufficient quantities of this gas could be found in the sources of natural gas in the United States.

Fresh opportunity for public service of the highest importance came with the formation of the Department of Scientific and Industrial Research in 1915. Threlfall was one of the original members of the Advisory Council, and remained a member until 1926. It would be no injustice to the other distinguished members of the Council during Threlfall's term of office to describe him as the hardest worked of any who had no direct responsibilities for the work of the research stations. The voluminous papers with which members of the Council were supplied to prepare them for the fortnightly meetings were scrupulously read through by Threlfall and marked copiously with his notes. His criticism could be trenchant, but was always constructive when possible, and seldom destructive without justice. His strong personality, his intense interest in the Department, and his sympathy with and understanding of all phases of the work, made him an invaluable member of the Council. He thoroughly enjoyed it all; he liked the fresh atmosphere, the opportunity of forming new friendships and renewing old ones, the feeling that he was useful and appreciated. The Department was fortunate indeed, in its formative years, to be able to command the services of one who was perhaps the most informed scientific man actively engaged in industry.

It was in the country that one got to know Threlfall best. A country squire himself by tradition and upbringing, he loved every phase of country life; one could not spend a day in the country with him without learning something fresh about Nature, and something, too, of the essential kindliness of the man. He was never happier than when by his beloved River Vyrnwy in North Wales, a long stretch of which he rented for fishing for more than twenty years. He liked to have his friends there, often depriving himself of his own fishing in order to put the expert visitor on to the best parts of the river, or to instruct the beginner. Indeed he overflowed with hospitality and geniality, loading his car with delicacies for his guests until, if boys were of the party, it looked like a travelling tuck-shop. Then there were the long evenings at the Wynnstay Hotel, Llanfyllin, when, after a hearty meal, and hearty laughter at good stories, and discourses on the art of fishing, he would sometimes talk of days gone by: of school days at Clifton and how he shared a study with Douglas Haig; of his classical education, which he thought was overdone ("I could never understand why so much importance is attached to the opinions of men who had access to so little information"); of early days with 'J. J.' at the Cavendish, and how he inoculated him with a lifelong passion for Rugby football; of his life in Australia as a youthful professor, and how he spotted Rutherford as a 'winner' within ten minutes of his entering his laboratory at Sydney on his way from New Zealand to Cambridge with an 1851 Exhibition; of Robert Louis Stevenson, who shut his bedroom windows in the

hottest month at Sydney because it was so cold compared with Samoa; of Ludwig Mond, Kelvin, Rayleigh, and a host of others; with sometimes a sigh for vanished youth—his strength was a byword at Cambridge in his day—but always a sturdy interest in life and work. A great man, the staunchest of friends, and a most lovable character.

H. T. T.

PROF. K. SUYEHIRO

PROF. KYOJI SUYEHIRO, director of the Earthquake Research Institute, Japan, died after a brief illness on April 9 (*Bull. Earthq. Res. Inst.*, 10, v, 1932). Suyehiro was born in Tokyo on Jan. 24, 1877, the second son of Mr. S. Suyehiro, a well-known writer and politician. In 1900 he finished his course on naval construction in the Imperial University of Tokyo, and two years later became assistant professor on that subject. In 1909 he travelled abroad, and on his return in 1911 was appointed titular professor in the University. In 1925 he founded the Earthquake Research Institute, of which he served as director until his death. He was also president of the Society of Naval Construction and of the Physico-Mathematical Society. Much of Suyehiro's work is connected with naval construction. In seismology, he studied and measured the oscillations of buildings, and last year he visited the United States in order to attend conferences on the influence of earthquake shocks on buildings. Not the least useful part of his work lay in the guidance and encouragement of his numerous students.

News and Views

Prof. J. E. Lennard-Jones

THE first occupant of the recently created John Humphrey Plummer chair of inorganic chemistry at Cambridge will be Prof. J. E. Lennard-Jones, of the University of Bristol. During his tenure of office at Bristol, first as reader in theoretical physics and later as professor and first holder of the Melville Wills chair in this subject in the Wills Physical Laboratory, Prof. Lennard-Jones has carried out a number of important investigations in the field of molecular physics. His earlier work on the forces between atoms in gases, and later, in crystals, was of fundamental importance and led him to the study of cohesion and other surface phenomena such as adsorption, as well as the structure of molecules in general. The results that he obtained attracted general attention and were particularly appreciated by physical chemists and metallurgists, both in Great Britain and abroad, because of the light that was thereby thrown upon some of the most fundamental problems of modern chemistry. The post to which Prof. Lennard-Jones has now been appointed affords special opportunities for the continuation of this co-operation between theoretical physicists and chemists, which in the past has been far less marked in Great Britain than on the Continent. On the other hand, the University of Bristol, with which he has been associated for seven years, suffers the loss of an original thinker, a brilliant expositor, and a capable administrator.

International Congress of Prehistoric and Protohistoric Sciences

THE first International Congress of Prehistoric and Protohistoric Sciences, held in London on Aug. 1–6, must be counted completely successful. Foreign visitors seemed thoroughly satisfied with the arrangements for their instruction and entertainment; while the whole-hearted manner in which British archæologists supported the meeting both by their attendance and by the contribution of papers, as well as the ready enthusiasm with which they entered into the discussion of mutually interesting problems with their colleagues from other countries, ensured that this new undertaking should at least be launched under favourable auspices. The number attending the Congress was approximately six hundred, and just under two hundred papers were accepted for reading—too large a number perhaps; but the careful arrangement of subdivisions and the classification of papers reduced the inconvenience of clashing to a minimum. A high standard was maintained; and a number of papers, to some of which we hope to refer at a later date, dealt with topics of great importance. Some communications from foreign visitors were perhaps of a more highly technical character than those to which a British audience is accustomed; but this was to be expected with a membership of which a considerable proportion was professional. It is only in Great Britain that that interesting and valued survival, the amateur as archæologist, flourishes to any appreciable extent.

SENSATION was not lacking at the Congress, as may be gathered from the accounts, which were somewhat exaggerated, in the daily Press. Among these was the announcement, a little premature, of the deposition of Oldoway man from his pride of place as the oldest specimen of *Homo sapiens*—for which the evidence appears elsewhere in our columns (see p. 237)—and the new conclusions relating to the Lloyd's skull, which Prof. Elliot Smith announced in his review of recent discoveries in human palæontology. Even his opening remarks gave his audience a surprise, for he stated that he had been asked by Dr. E. Dubois to announce his recent discovery of three femora of *Pithecanthropus* among the material he brought from Java in 1900, which support the classification of that type as a true genus, and by their form justify the epithet *erectus*. Prof. Elliot Smith, however, pointed to the possibility of a connexion with Ngandong man, to the recent discovery of which he also referred. In regard to the Lloyd's skull, he made the remarkable announcement that this is now to be regarded as by far the oldest known representative of *Homo sapiens*. Dr. Matthew Young has made a statistical comparison

of the fragment with the skulls of a number of medieval women from Glasgow, which also show the abnormality of a supra-occipital bone such as is present in the Lloyd's skull, and has found it in all essentials of the modern type; while Miss Garrod, after a re-examination of the stratigraphical and archæological evidence, has arrived at the conclusion that it is Mousterian, or even earlier.

Ancient Cave-Dwellers in Texas

FROM the point of view of the student of the ancient cultures of North America, the investigations which are now being carried out by the Smithsonian Institution of Washington in the south-western United States are at present by far the most interesting in American archæology. It would seem well within the bounds of probability that the Basket-Maker–Pueblo sequence will be amply documented at no very distant date, if researches continue to be prosecuted with the vigour and success of the last few years. The Smithsonian Institution now announces the successful result of an expedition, of which Mr. Frank M. Setzler was in charge, to Texas. This expedition has just returned to Washington after exploring seven caves spread over a wide area in the Big Band and Chisos mountain region of south-eastern Texas. A considerable amount of cultural material was found, which points to the caves having been the permanent habitation of a very primitive race of Indian, unfortunately without any indication of its affinities. It is possible that it may be related to the Basket-Makers of Arizona and New Mexico, who were partially cave-dwellers; but there are differences in culture, especially in the basketry and arrow-shaft techniques. The food of the Texan cave-dwellers appears to have been principally cactus, of which they chewed the pulp and spat out the fibre. This was supplemented by the flesh of bear, deer, rabbits, and birds of all kinds. Their clothing and baskets were woven of cactus fibre. The most remarkable custom, however, was that of burying the body of a small child, never more than two years old, in the exact centre of the caves which were their dwellings, a characteristic they shared with some of the ancient Mayas.

Research Management and Budgeting

To a symposium on the management of research, appearing in recent issues of *Industrial and Engineering Chemistry*, W. A. Hamor and G. D. Beal contribute a paper on the control of research expense (April 1932, p. 427). The recognition of the importance of planning and control in management, which has become widespread during the last ten years, has led to the administration of research being placed on a much more accurate basis. The progress in the control of research expenses made possible by systematic planning and budgeting has been to the joint advantage of management, technology, and science in that due attention can be given, in planning research, to the probability of the solution of a problem at a cost commensurate with its value. All research expense cannot, of course, be reduced to a method of accounting, but positive savings which can be classified should be accounted as such and duly credited against the improvement in process efficiency, reduction or disposal of wastes, patents, etc., the remaining research expense concerned with the maintenance of quality through control, improved, or novel products being charged off to product and market improvements.

AN accounting system will guard against the numerous uneconomical practices and wastes that can easily creep in and fritter away resources of time or material. Budgetary control is quite possible in spite of being based on estimates because it is not a substitute for management; and when reasonably close estimates have been prepared, the expenditure of the sum to the most advantage will largely depend upon the director. The methods of control adopted, while sufficiently elastic, should enable time and materials to be costed up against the laboratory investigation on which they have been expended, whether improvement of existing processes or products or the discovery of new products or processes, other expenses such as cleaning, light, heat, power, etc., being charged on a *pro rata* basis. In such budgeting and control, the question of salaries and increases of salary and travelling allowances will be considered from a broad point of view, calculated to encourage the development of scientific enthusiasm and the stimulus of contact with other professional workers at scientific meetings.

Volcanic Steam for Power Generation

ON July 22, Prince Ginori Conti gave a lecture to the International Union of Power Producers at the hall of the French Institution of Civil Engineers. The possibility of utilising the heat energy in the interior of the earth has frequently been considered by engineers, but in practice it is necessary that the heat be localised near the surface of the earth if this is to be done on a commercial basis. In Tuscany, not far from Florence, Prince Conti has an installation in a volcanic region where low pressure steam issues from cracks in the ground. A system of boring has recently been adopted to obtain the vapour at a higher pressure and increase its volume. The vapour is charged with sulphur, borax, and carbon dioxide. For many years borax has been obtained from the ground round the vent-holes, on which much of the vapour was condensed. Owing to the corrosive nature of the vapour, it was very difficult to design suitable apparatus. At one of the stations the steam generated in the boilers is used to supply suitable low pressure turbines. At another station high pressure steam is employed. Aluminium is used for the conductors in the stations, as copper corroded much too quickly. The total capacity exceeds 12,000 kilowatts, but there are several difficulties still to be overcome. The problem is simpler at Sonoma, in California, where the unwanted gases are easily eliminated from the vapour. The hot vapour is found at depths of between 100 and 200 yards. At present this station supplies 11,000 kw. to the surrounding district. According to *World Power* of July, there is a large quantity of power available in the volcanic regions of Bolivia.

B.D.H. Products

WE have received from the British Drug Houses, Ltd., London, N.1., copies of their catalogues of fine chemical products and micro-analytical reagents and organic reagents for 'spot' tests. The standards of purity adopted for chemical products are described in the B.D.H. book of A. R. Standards and those for pharmaceutical preparations in the book of P.P.P. (pure for pharmaceutical purposes) Standards. In the case of the latter, other considerations as well as purity must be taken into account, for example, ease of weighing for dispensing, and ready solubility with the formation of a clear bright solution. Low limits for lead and arsenic are defined, being in the case of most substances only a few parts (1 to 5) in a million. Other metallic impurities may not be physiologically harmful, but may cause precipitation, coloration, or some other reaction and so create difficulties in dispensing: their limits must therefore be fixed as well. The catalogues of fine chemicals run to nearly 150 pages and include lists of standard reagents, indicators, microscopic stains, and dyes. The same firm has also issued recently revised editions of booklets describing their vitamin A and vitamin D preparations, avoleum, radiostol, radiostoleum, and radio-malt. Advance in our knowledge in the vitamin field has been so rapid that frequent revision of brief summaries of this work is required. The activities of the products are controlled by physiological tests and standardised in terms of the international standards wherever such standards are available.

Treatment of Leprosy

DERIVATIVES of chaulmoogra and hydnocarpus oils now have an established position in the treatment of leprosy. The active constituents are certain fatty acids, which are usually administered as their soluble sodium salts or as the ethyl esters. A mixture of esters of the acids of the chaulmoogric series with 0·5 per cent iodine has been recently recommended for the intradermal treatment of the superficial lesions of the disease: the addition of the iodine reduces the irritating properties of the ethyl esters. The intradermal method is relatively free from general and local reactions: rapid resolution of the raised macules, infiltrations, and nodules is reported when small amounts of the solution of esters and iodine are injected into the skin around them. Messrs. Burroughs, Wellcome and Co., London, have issued a solution of these esters with 0·5 per cent iodine, suitable for intradermal and intramuscular administration, under the name "Iodised Moogrol". It is recommended that 5 c.c. be given at weekly intervals: the intradermal injection should be 0·1 c.c. at each point. Intradermal administration should be combined with intramuscular, part of the dose being given by each route.

Oceanography of the Baffin Bay Region

THE United States Coastguard in 1928 sent an expedition in the ship *Marion* into Davis Strait and Baffin Bay to carry out scientific investigations connected with the international ice patrol, particularly in regard to ocean currents, ocean depths, and ice conditions in the region north of that usually covered by the ice-patrol vessels each spring and summer. The ship followed a zigzag track northward from the Gulf of St. Lawrence to and fro between Labrador, Greenland, and Baffin Island. An account of the expedition and its results are being issued as the U.S. Coastguard *Bulletin* 19, published in three parts. Part 1 (Washington: Government Printing Office, 1932; pp. 81, 50 c.), just issued, contains a fascinating narrative of the cruise, illustrated by 38 well reproduced photographs; it gives also a report and discussion of the sounding work accomplished (by the echo method), and a description and discussion of the bottom samples obtained at some of the places where wire soundings were made. Part 3, published last year, dealt with the arctic ice and its drift into the North Atlantic Ocean, while Part 2, to be issued shortly, will report on the oceanography of Baffin Bay and Davis Strait.

Physiography of the Nile Basin

IN recent years a great deal of information on the Nile basin, the regime of the Nile, and the control of its floods has been collected by the Irrigation and Physical Department of the Egyptian Ministry of Public Works. This has resulted in a series of valuable papers, including the volumes on the Lake Plateau Basin of the Nile published in 1925 and 1927. This work continues and is being correlated with meteorological and hydrographical work in Uganda and other parts of East Africa. The Irrigation and Physical Department has now published the first of a new series of volumes on the Nile ("The Nile Basin." H. E. Hurst and P. Phillips. Physical Dept. Paper 26. Cairo, 1931. P.T.50). It deals particularly with the topography of the Lake Plateau, Bahr-el-Jebal, Bahr-el-Ghazel, Sobat basin, and White Nile basin, with a full account of the meteorology of the whole basin. A feature of the book is the large number of coloured folding maps, including maps of the whole basin on a scale of 1 to 2,000,000. There are also numerous climatic maps and many excellent illustrations. The volume concludes with a long bibliography of the Nile.

Plains of Southern Alberta

A REGION embracing such well-known names to the petroleum technologist as Calgary, Turner Valley, Bow Island, and Medicine Hat, will always preserve a certain freshness, but more because of its oil and gas industry than on account of any special geological merit. Yet the Alberta Society of Petroleum Geologists has made much lately of its stratigraphy and palæontology, and publications concerning these aspects of research have not been by any means restricted. As is often the case where a sense of vastness seems to engulf human effort, so in the Southern Plains has much of the significance of disconnected work been lost to the wider fraternity of geologists. The Donaldson Bogart Dowling Memorial Symposium on this stratigraphy (Tulsa, Oklahoma: Amer. Assoc. of Pet. Geol.; London: T. Murby and Co. 3 dollars) is not only a happy thought to the memory of a

man who probably knew his "Plains" better than any other, but also a genuine effort at co-ordination and presentation of the results of carefully focused investigations. It might, however, have been substantially improved by a more complete summary of the present position of our knowledge, by way of introduction to the several contributions, than is attempted in the brief foreword; this, though sufficiently lucid so far as it goes, still leaves to the reader the task of fitting together the various pieces of evidence to make a pleasingly intelligent picture of the whole.

Index of Publications of the Royal Society

The Royal Society has issued in one alphabet an author index to its *Proceedings*, Series A and B, from 1905 to 1930, and to the *Philosophical Transactions*, Series A and B, from 1901 to the same year, the entries being arranged chronologically under each heading. A previous index to the *Proceedings* was published in 1913, which covered the period from 1800 (when the series began under the title "Abstracts of Papers printed in the Philosophical Transactions") to the year 1904, so that the author index to this publication is now complete to the year 1930. The only indexes to the *Philosophical Transactions* hitherto available have been author and subject indexes down to the year 1830, but the "Catalogue of Scientific Papers", which includes papers in the *Philosophical Transactions*, may be considered to continue the indexing under authors' names down to the year 1900, whence the new volume completes it to the year 1930. So far as the author index is concerned, therefore, the indexing of the two publications is available for their entire runs. A subject index from 1800 is still lacking, except in so far as the mathematical, mechanical, and physical papers for the period 1800–1900 are concerned, since these have been included in the three published subject indexes to the "Catalogue of Scientific Papers", which covers both publications.

Science and Letters in Poland

The principal contribution to vol. 15 of *Nauka Polska* (Polish Science), which has recently appeared, is Prof. Z. Szweykowski's account of the Institute for the Promotion of Science and Letters in Poland. This Institute, which is to-day under the patronage of Prof. I. Mościcki, the President of the Polish Republic, and himself a distinguished chemist, was founded in 1881 in difficult circumstances from the Mianowski Fund. It has had a chequered history, but the Mianowski Institute now occupies the spacious Staszic Palace, and its future is assured. The aim of this Institute is the furtherance of all branches of science in Poland. It has already published or supported financially the publication of 1200 volumes and the preparation of 200 scientific works, and has subsidised fifty scientific periodicals. In addition, it has made grants to some fifty societies, research laboratories, and museums. The same volume of *Nauka Polska* includes a comprehensive survey of the progress of science in Poland between 1800 and 1880 by Prof. F. Bujak. It constitutes a summary of the works of Polish men of science during the greater part of last century. Other articles deal with the present-day needs of applied physics, the position of the State libraries in Poland, and the scope and organisation of the Institute for Slavonic Studies.

Habits of Bats

In the *Journal of Mammalogy* for May (p. 133) Mr. C. E. Johnson gives some notes on a family of red bats (*Lasiurus borealis borealis*) in captivity, and mentions that the old female, when let loose indoors, alighted more than once on the floor, and rose as easily as a bird. In the eighteenth century, Gilbert White alludes to a tame bat he saw, which several times confuted the vulgar opinion that bats could not rise from a flat surface, by rising with great ease from the floor; and the writer of this note has found the common yellow bat of India (*Nycticejus kuhli*) and the collared fruit-bat of Africa (*Rousettus leachi*) also quite able to take wing from the flat. These examples are worth giving because the error mentioned by White still persists, and in quarters where 'vulgar opinion' might not be supposed to be the vogue. The fact is that a bat does not voluntarily remain on the flat in the open, but may no doubt be found there unable to rise owing to some incidental disability, just as a man may be found lying helpless on a pavement for a similar reason.

Safety in Mines

The Safety in Mines Research Board has recently issued its tenth Annual Report, which contains a good deal of matter of scientific interest. Perhaps the part that will be most widely read is Appendix No. 9, which refers to researches intended to obviate fatalities from falls of ground. It commences by a record of researches on the strength of supports, etc., carried out under the direction of Prof. S. M. Dixon, and, furthermore, contains summaries of the results obtained by the various district committees working on the subject throughout Great Britain. The body of the Report shows considerable activity on the part of the Board, and indicates how greatly the scope of the work has been extended and how much has been done to make the results accessible to mining men generally. It must, however, be admitted that the work so far has been rather of the nature of collecting scientific material which will, no doubt, be useful at some future date in increasing the safety of mining, for up to the present the results obtained are of scientific interest rather than of practical importance.

American Railway Progress

The issue of the *Journal of the Franklin Institute* for March contains the address of Mr. W. C. Dickerson, president of the American Locomotive Company, on the progress made during the interval 1920–30. The 15 charts reproduced allow it to be readily seen. The weight on the driving wheels of the goods locomotive has increased from 245 to 247 thousand pounds, but the drawbar pull, at 28 miles an hour, from 32 to 50 thousand. For the passenger locomotive the corresponding figures are 192 to 187 and 18 to 44 thousand

pounds, at 60 miles per hour. Engine runs have been increased from 140 to 400 miles, crews being changed at intervals. As a result there are fewer locomotives in use to-day than ten years ago. Goods waggons have increased in size and decreased in number, and ordinary passenger coaches have been replaced by Pullman cars. The ton miles for goods have risen from 410 to 447×10^9, but the passenger miles have fallen from 47 to 31×10^9. Revenue increased from 6·2 to $6{\cdot}3 \times 10^9$ and operating expenses decreased from 5·8 to $4{\cdot}5 \times 10^9$ dollars. Mr. Dickerson is not satisfied that 45 per cent of the locomotives in use are more than twenty years of age. He shows that it is in the end more economical to replace old locomotives rather than to rebuild them. He considers that the diesel-electric locomotive has a wide field of usefulness.

Smoke Abatement

THE *Quarterly Journal* of the National Smoke Abatement Society, issued by the Society, 23 King Street, Manchester, among other things analyses the progress of smoke abatement as revealed by the latest Report on Atmospheric Pollution issued by the Department of Scientific and Industrial Research. This records for the average of a number of stations a decrease in 'total deposits', in tar, and sulphate averaging 16 per cent, 24 per cent, and 19 per cent respectively. While this decrease may partly be due to industrial depression, it is concluded that there has been a definite reduction of domestic smoke. Some of the figures, if correct, suggest that current ideas require revision. While the atmosphere of industrial cities seems to be improving, conditions in London get worse, and now appear to be similar to those of Hunslet—an industrial area in Leeds. Again, the suburbs of Leeds yield figures better than those of Southport. Such comparisons will suggest the need for caution in interpretation, but the figures show that conditions can be improved, and the *Journal* does a good service in emphasising this.

Food Technology

REFERENCE has previously been made in these columns to the problems of food preservation and their importance to modern civilisation. The more scientific aspects of the subject are dealt with in the reports of the Food Investigation Board and the Empire Marketing Board, and references to the extensive literature on the subject can be found in the "Index to the Literature of Food Investigation". *Food Technology* is described as a monthly review of manufacture, packing, and transport for production managers, food chemists, and engineers, and is designed to make known the work of research centres and to secure greater publicity for their achievements. The journal contains articles on different aspects of the food trade, answers to readers' inquiries, and notes on recent patents, amongst other features. It appears that it should fulfil its object of keeping those engaged in modern food factories in touch with research work on the treatment of food, as well as with the necessary auxiliary trades. It is edited by Dr. H. D. Law, 153 Stratford High Street, London, E.15; price 12*s*. a year.

Best Books in 1930

UNDER the title "Best Books of 1930" a selected list of books published during that year has recently been issued by Mr. Alex. J. Philip, "Lodgewood", Gravesend, and Messrs. Simpkin Marshall, Ltd., London, E.C.4. The list is classified on the Dewey Decimal System and has been selected with the help of many authorities, institutions, and societies. The main headings of the classification include general, philosophy, metaphysics, religion, sociology, philology, science, arts, literature, and history, and these are subdivided into their various groups. About 2500 "Best Books" are thus classified for the year 1930. Such a list should prove useful as a work of reference, and should be an asset to all lending and reference libraries, as well as to departmental and institutional libraries. Nevertheless, we venture to suggest that since the comparative value of a book is often a matter of opinion, such a selected list cannot be expected to be anything other than a tentative guide to choice.

Announcements

THE Third International Congress of Cytology will be held in Cambridge at the end of August 1933. Further particulars will be published in due course.

MR. I. W. M. ARMSTRONG-BLACK has been appointed assistant agricultural chemist, Nyasaland (Colonial Agricultural Service).

A SHORT training course for curators and assistants has been arranged by the Museums Association to be held at Manchester on Sept. 27–30. The course will be devoted to the study of the technique and administration of science and art museums and galleries, and will include visits to the Manchester Museum at the University, the Manchester City Art Gallery and branches, the Whitworth Art Gallery, and the Royal Museum and Art Gallery, Salford. No fees will be charged for attendance. Applications for grants towards students' expenses in attending the course will be considered by the Committee and should be addressed to the Secretary, The Museums Association Short Training Course, Public Museum, Bootle.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant agricultural chemist in the Department of Agriculture and Horticulture at the University of Bristol—Agricultural Advisory Office, 22 Berkeley Square, Bristol (Aug. 20). A lecturer in mechanical engineering at the Municipal Technical College, Hull—The Director of Education, Education Offices, Guildhall, Hull (Aug. 20). A principal of the Lester Technical School and Institute, Shanghai—The Secretary, Association of Principals of Technical Institutions, Chelsea Polytechnic, Manresa Road, S.W.3 (Sept. 1). An attendant for the Departments of Botany and Zoology at the North of Scotland College of Agriculture—The Secretary, 41½ Union Street, Aberdeen. An assistant tobacco chemist in the Chemical Laboratories of the Ministry of Finance, Egypt—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, London, S.W.1.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Artificial Disintegration by Neutrons

FOLLOWING up the experiments already reported,[1] I have recently taken 1490 pairs of photographs of the tracks produced in an expansion chamber filled with oxygen (97 per cent by volume) when a source of polonium and beryllium was placed in the centre. The conditions of experiment and the source itself were the same as in the previous work, the initial pressure of the gas being roughly atmospheric.

About sixty recoil tracks were obtained and, in addition, seven or eight examples of paired tracks, providing certain evidence of disintegration. These numbers may be compared with about a hundred recoil tracks and thirty disintegration pairs recorded in the nitrogen photographs (1740 in number). It appears, therefore, that the disintegration probability for neutron-oxygen nucleus encounters, though doubtless somewhat smaller, is yet of the same order of magnitude as that which characterises similar encounters with nitrogen nuclei. This is in itself an interesting result, for hitherto no certain evidence has been obtained for the artificial disintegration of oxygen —either by α-particles or protons.[2]

The disintegration photographs have been examined and measured by the stereo-reprojection method previously employed. It appears likely that in all cases so far observed, disintegration has occurred with capture of the incident neutron. If that be accepted, then the disintegration particle is almost certainly an α-particle. The nuclear reaction may be written

$$O^{16} + n^1 \longrightarrow C^{13} + He^4.$$

(From momentum relations alone it is practically impossible to distinguish this process from that in which the resulting nuclei are C^{12} and He^5, but for the present this latter possibility may be passed over.) In the accompanying table, E, the kinetic energy of the responsible neutron, and W, the energy absorbed in the disintegration process, are given as deduced for the eight cases observed. The energy unit employed is 10^6 electron volts.

No.	1	2	3	4	5	6	7	8
E	7·0	7·0	6·2	7·6	4·2	5–7	4–7	2·2
W	2·2	4·3	3·5	5·2	1·7	1·0	2·5	1·2

Numbers 1 to 4 may be regarded as satisfactory, with a probable error of $0·5–0·7 \times 10^6$ e.v., numbers 5 to 7 carry somewhat less weight, and number 8 is rather doubtful.

The results as a whole, however, show that the capture disintegration in question takes place with the absorption of energy, the amount absorbed being different on different occasions. This probably means that in some cases the nucleus C^{13} is left temporarily in an excited state, afterwards emitting a quantum of γ-radiation in its return to the normal. Now, this nucleus is also produced in the artificial disintegration of boron by α-particles, and the existence of proton groups having an energy separation of 3×10^6 e.v. and of the accompanying γ-rays are established facts.[3] Some such energy difference as this is consistent with the values of W given above.

The neutron energies given in the table are in general somewhat greater than those deduced in most of the cases of capture disintegration in nitrogen. The energies deduced from recoil track measurements, on the other hand, were in complete accord with the nitrogen results. It is possible that the smaller disintegration yield in oxygen is the necessary consequence of the greater mean energy required for disintegration; moreover, the present results confirm the suggestion that a small fraction of the radiation from beryllium is of higher energy than was previously believed to be the case. This suggestion was first made by Curie, Joliot, and Savel from other considerations.[4] We may conclude, in fact, that the upper limit of energy of $6·4 \times 10^6$ e.v. previously obtained is appreciably too low.

The experiments here described are being continued with oxygen at greater dilution, in the hope of increasing the accuracy of measurement and further investigating the disintegration phenomena which occur.

N. FEATHER.

Cavendish Laboratory,
Cambridge, July 28.

[1] *Proc. Roy. Soc.*, June 1932.
[2] Cockcroft and Walton, *Proc. Roy. Soc.*, A, **137**, 229; 1932.
[3] Chadwick, Constable, and Pollard, *Proc. Roy. Soc.*, A, **130**, 463; 1931. Becker and Bothe, *Z. Phys.*, **76**, 421; 1932.
[4] *C.R.*, **194**, 2208; 1932.

The Oldoway Human Skeleton

DR. L. S. B. LEAKEY's claim that the Oldoway man of *Homo sapiens* type was buried in Bed 2 of his succession, before the formation of the overlying Beds 3 and 5, rests on his statement that no material from Beds 3 and 5 was found in intimate association with the skeleton in the burial, although such material is found lying on the present surface-slopes of the gorge at and near the site.[1]

On discussing the matter with Prof. D. M. S. Watson and Mr. A. T. Hopwood, I came to the conclusion that more thorough investigation of this critical evidence was desirable, especially as subsequent alteration of rock-material in the neighbourhood of the skeleton might have rendered it less easily recognisable than in its unaltered condition. I therefore suggested that the deposits of Beds 2, 3, 4, and 5, as well as the material found within the ribs of the skeleton, should be carefully re-examined. Mr. Hopwood kindly supplied typical samples of Beds 2, 3, 4, and 5 collected by him at Oldoway. The petrological investigation of the deposits was undertaken at the Imperial College by Dr. J. D. Solomon, who had formerly worked with Dr. Leakey in East Africa and was familiar with the occurrence of similar beds in the field. Dr. Solomon found that each of the deposits possessed distinctive lithological and mineralogical characters. The way now being clear for a useful examination of the grave-contents, Prof. Reck, at Mr. Hopwood's request, persuaded Prof. Th. Mollison of Munich to send us a sample of material which, he assures us, was part "of the material in which the Oldoway skeleton had been embedded". Dr. Solomon, Mr. Hopwood, and I together examined this material. It contains (*a*) pea-sized bright-red pebbles like those of Bed 3, and (*b*) chips of concretionary limestone indistinguishable from that of Bed 5 and enclosing at least one mineral (an amphibole), in relative abundance, not found in Beds 2 and 3, but present in Bed 4.

Assuming, therefore, that the provenance of the materials supplied to us is as stated (and we have no reason to doubt it), the Oldoway interment is not contemporaneous with Bed 2 containing Chellean-

Acheulean implements, but was made after the formation of the concretionary limestone ('steppe-lime') of Bed 5, that is, is post-Aurignacian.

The samples are being kept for reference in the British Museum (Natural History), South Kensington.

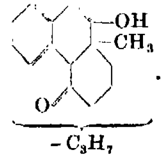
P. G. H. BOSWELL.
Department of Geology,
Imperial College of Science and Technology,
London, S.W.7, July 29.

[1] NATURE, 129, 721, May 14, 1932.

Chemical Constitution of the Follicular and Testicular Hormones

Follicular Hormone

IN a paper published recently by Butenandt and his co-workers,[1] the hypothetical formula (I) was developed for the follicle hormone.


. . . . . (I)

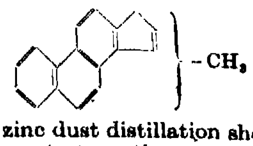
This formula attempted to correlate the X-ray measurements of J. D. Bernal,[2] which made a three-ring system for the hormone probable, with the chemical evidence at that time in hand.

A series of new experiments up to the present have not substantiated formula I, but indicate that in the hormone molecule there are only three aromatic double bonds (a benzene ring) present, that is to say, four rings altogether.

(1) Even by most energetic catalytic hydrogenation, only three double bonds are saturated in the hormone and hormone hydrate molecule. The following derivatives were prepared: Hexa-hydro-hormone-hydrate $C_{18}H_{27}$ $(OH)_3$ (F.P. 256°), Hexa-hydro-desoxy-hormone-hydrate $C_{18}H_{28}-(OH)_2$ (F.P. 153°), Hexa-hydro-desoxo-hormone $C_{18}H_{29}.OH$ (F.P. 105°). All three alcohols react as completely saturated substances. The hexa-hydro-hormone-hydrate, which was the product most fully investigated, is completely stable towards potassium permanganate, perbenzoic acid, and ozone. As in the case of the other alcohols, it gives no reaction with tetranitromethane.

(2) Careful *molecular refraction measurements* of the hormone hydrate, its acetate, and its methyl ether, as well as of the desoxo-follicle hormone, $C_{18}H_{23}.OH$ (F.P. 133°), give values which completely agree among themselves, and are only compatible with a hormone formula containing three isolated double bonds or one benzene ring. These results are of especial interest, because hormone formula (I) demands increments not only for four double bonds, but also a marked exaltation due to the conjugation of the enolic double bond to the benzene ring.

(3) *Attempts at dehydrogenation* with electrolytic zinc dust produced an aromatic hydrocarbon (F.P. 234°), which is perfectly stable towards potassium permanganate, and, according to the analyses and molecular weight determinations to date, has the formula either $C_{18}H_{14}$ or $C_{17}H_{14}$. This formula points to the existence of four rings (for example, three benzene rings and one five-membered ring).


. . . (II)

Inasmuch as a zinc dust distillation should be applied only with the greatest caution to a structural determination, these results are given only as contributory evidence pointing to the existence of a four-ring structure in the hormone molecule.

The discrepancies of these results with the measurements of Bernal[2] and with the 'enolic nature' of one of the three aromatic double bonds[3] must be fully investigated before a decision can be reached regarding the basic skeletal system.[4] The similarity of formula II to the new formula recently suggested by Wieland and Windaus[5] for the sterols, bile acids, and pregnandiol, indicates the possibility that the hormone is closely related to these compounds.

Testicular Hormone

During the past year, four different crystalline products have been isolated from the oily fraction of human male urine which is highly active in the cock's comb test as well as on the vesicular glands of rodents.[6] These products are at present being investigated. The tentative results, which have been carried out on extremely small amounts of substance, give the following picture, the details of which must all be confirmed:

(1) Substance, $C_{18}H_{28}.(OH)_2$, F.P. 232°, isomeric with hexa-hydro-desoxy-follicle-hormone-hydrate; $\alpha = +16.6°$; acetate F.P. 112°.

(2) Oxy-ketone, $C_{18}H_{30}O_2$ or $C_{17}H_{28}O_2$, F.P. 163°, $\alpha_D = +76°$, oxime F.P. 216°.

(3) Oxy-ketone, $C_{16}H_{26}O_2$ (?), F.P. 176·5°, $\alpha_D = +89.9°$, acetate F.P. 158°, oxime F.P. 215°.

(4) Oxy-ketone, $C_{16}H_{26}O_2$ (?), F.P. 178°, acetate F.P. 160°.

Only the last-mentioned oxy-ketone, F.P. 178°, produces high physiological activity in the smallest doses in the capon test, and is to be considered as the hormone producing comb growth. A total of 1-1·2 γ given in four doses within two days produces a growth effect up to 30-35 per cent in the area.

The remaining crystalline products appear to be completely inactive as regards growth of the comb when they are absolutely pure, even in doses 600 times as strong (detectable activity in the larger doses might be due to traces of the hormone). The physiological activity of the crystals on the genital tract of rodents is at present being investigated.

A. BUTENANDT.
Laboratory of General Chemistry,
University of Göttingen.

[1] Z. physiol. Chem., 208, 149; 1932.
[2] Chemistry and Industry, 51, No. 12; 1932.
[3] Z. physiol. Chem., 208, 153; 1932.
[4] Marrian and Haslewood (Lancet, Aug. 6) have just put forward evidence which also shows that only three double bonds are present in the molecule. They also suggest a four-ring structure.
[5] Several papers in press by Wieland and by Windaus.
[6] Z. angew. Chem., 44, 905; 1931.

Gill-Morrell and Barkhausen-Kurz Oscillations

MR. R. COCKBURN has shown that with one vacuum tube he obtained by means of the Barkhausen-Kurz method electromagnetic oscillations of two kinds.[1] These oscillations differed one from the other by the dependence of their wave-length on the length of the oscillating circuit connected with the tube. One of these oscillations he referred to as the *GM*-type and to the other one as the *BK*-type.

The oscillations with similar dependence of the wave-lengths on the length of oscillating circuits as described by Mr. Cockburn were obtained by us several times with different vacuum tubes. These oscillations we obtained by means of a generator of our usual construction[2] which had oscillating circuits in the plate and in the grid circuits of the tube. The oscillations obtained by us, and similar to those referred to by Mr. Cockburn as the *GM*-type, corre-

sponded to those parts of the regions of oscillations of the 'working diagrams' of the tubes[3] for which the grid potential E_g was near to the potential E_s of the upper bend of the statical $I_s E_g$-characteristics of the tube. The oscillations similar to those referred to by him as the *BK*-type corresponded to the same regions of oscillations but to potentials $E_g > E_s$. Fig. 1 confirms this, showing the dependence of the wave-lengths of the oscillations on the length of the plate and grid circuits. These latter were always in resonance with each other. The measurements were performed with a constant heating current and at constant grid potentials.

It is seen from Fig. 1 that the oscillations corresponding to $E_g = 100$ v., 120 v., and 150 v. ($> E_s$) do really differ from the oscillations corresponding to $E_g = 50$ v. ($< E_s$). The wave-lengths of the former depend on the length of the oscillating circuits rather less than the wave-lengths of the latter. In spite of this difference, it is impossible to refer to one of these oscillations as the *BK*-type and to the other as the *GM*-type.

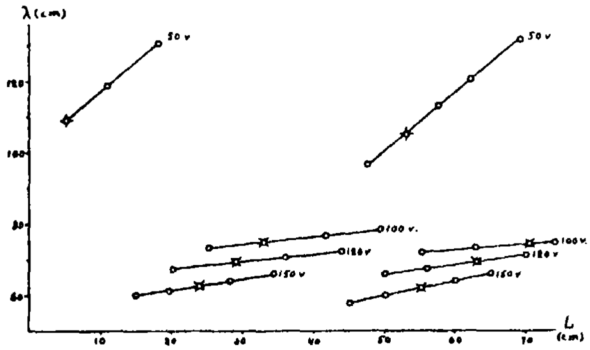


FIG. 1.—The dependence of the wave-lengths λ on the length L of the oscillating circuits; ⌘ the observations corresponding to the maximum of the energy of the oscillations.

With full confidence, all of them could be referred to as one and the same type of *GM*-oscillations. The greater dependence of the wave-lengths on the length of the oscillating circuits at $E_g < E_s$ is due to the fact that these potentials are limiting, that is, further decrease of E_g causes a cessation of the oscillations. Because of this, the oscillating 'regime' at $E_g < E_s$ is less stable than at $E_g > E_s$, and all external factors, including the variation of the length of the oscillating circuits, produce a greater influence on wave-lengths.

The results of Mr. Cockburn's investigations, as it seems to us, also do not give grounds to refer to the oscillations described by him as different types. In any case, no one of these oscillations can be referred to as the *BK*-type, because all of these are dependent more or less on the length of the oscillating circuits. Such a dependence cannot exist in the case of *BK*-oscillations. Unfortunately, using Mr. Cockburn's measurements, one cannot show with confidence the cause of the difference between the two oscillations described by him. This is due to the fact that during the observations he changed simultaneously the emission current and the length of the oscillating circuits. But, as is well known, the wave-length depends on both of them. It seems to us therefore very desirable that the conditions of observations should be changed in the future in such a manner that the dependence of the wave-lengths on the emission current and on the length of the oscillating circuits may be investigated separately.

In connexion with Mr. E. C. Megaw's letter,[4] we should like to point out that in our opinion the rôle of the space charges in the process of the generation of the *GM*-oscillations is rather limited, at least in the modern gas-free tubes. The generation of such oscillations is defined by the fulfilment of the conditions[5]

$$T = \tau, \frac{\tau}{2}, \frac{\tau}{3}, \ldots \qquad (M)$$

where T is the natural period (fundamental or overtone) of the oscillating circuit in which the oscillations arise and τ *is the time necessary for the electrons to* pass from the filament to the plate and back to the filament. In the case of tubes with close mesh grid, τ is a shorter time, since in this case the electrons will go from the filament to the plate and back to the grid only.[6] The condition $T = \tau$ corresponds to the 'normal waves', and the conditions $T = \tau/2$, $\tau/3$, ... correspond to the 'dwarf waves', that is, waves of higher orders.[7] In the case of a fulfilment of one of the conditions (M) the tubes can transmit energy into the corresponding oscillating circuit and can maintain their oscillations. The rôle of the space charges generally is to influence the time τ of the passage of the electrons. In rare cases, when the natural period of the space charges[8] will coincide with T and τ or with T and $\tau/2$, $\tau/3$, ... the intensity of oscillations must increase considerably. The oscillations described by G. Breit, H. Hornung, and by W. H. Moore[9] must be referred to these cases.

G. POTAPENKO.
Norman Bridge Laboratory of Physics,
California Institute of Technology,
Pasadena, May 28.

[1] NATURE, **129**, 202, Feb. 6, 1932.
[2] G. Potapenko, *Z. techn. Physik*, **10**, 542-548; 1929: *Phys. Rev.*, **39**, 625-637; 1932.
[3] G. Potapenko, *Phys. Rev.*, **39**, 638-665; 1932.
[4] NATURE, **129**, 542, April 9, 1932.
[5] G. Potapenko, *Phys. Rev.*, **38**, 584; 1931.
[6] H. E. Hollmann, *Ann. Physik*, **86**, 129-188; 1928.
[7] We avoid calling the 'dwarf waves' 'harmonics' or 'overtones' for the reason that they are not such in a usual meaning of these words, because they are generated completely independently of the 'normal waves'. In several cases, for example in absence of a suitable oscillating circuit, the 'normal waves' can generally be absent, but that does not preclude the generation of the 'dwarf waves'. The 'dwarf waves' have also a different character of dependence on the heating current from the 'normal waves' (see *Phys. Rev.*, **39**, 542; 1932). Because of all this, the similarity between the conditions (*M*) and the series of harmonical overtones is purely superficial.
[8] Concerning the natural period of the space charges see Th. V. Ionescu, *C.R.*, **193**, 515-577; 1931; and A. Rostagni, *Atti della R. Ac. di Torino*, **16**, 123-130, 217-223, 383-395; 1931. These authors place more importance on the rôle of space charges in the process of generation than we do.
[9] G. Breit, *J. Franklin Inst.*, **197**, 335-358; 1924: H. Hornung, *Ann. Physik*, **1**, 417-456; 1929: W. H. Moore, *Canad. J. Research*, **4**, 505-516; 1931.

Heats of Dissociation and the Periodic Law

LOTHAR MEYER's curves illustrating the periodicity of the physical properties of the elements are capable of extension to the heats of dissociation of simple compounds, not merely in the same group, but also in the same period. While interpreting results obtained by the examination of the infra-red spectra of triatomic molecules, Mr. A. B. D. Cassie and myself were able to show that a direct ratio exists between the heats of dissociation of certain related molecules and the force constants for the bonds concerned.[1] Two illustrations are given in the following table:

Molecule.	$K \times 10^{-5}$ dynes/cm.	*H.D.* kcal.	*K* ratio.	*H.D.* ratio.
CO	18·8	237	—	—
$\frac{1}{2}CO_2$	14·2	182	13·2	13·1
CS	8·4	158	—	—
$\frac{1}{2}CS_2$	6·9	132	1·2	1·2

Henri, from the extrapolation of the ultra-violet band spectrum of CS, had previously obtained the value of 193 kcal. for the heat of dissociation of this molecule; since the publication of our paper, he has shown that this value represents dissociation into a

normal C atom and an excited (^1D) S atom. Similarly he has determined from his own experimental results a heat of dissociation for SO of 148 kcal. and regards this as giving normal S and O atoms. Since the heat of dissociation of the oxygen molecule is only 118 kcal., the experimental value for SO is evidently too great. We have shown that the force constant for SO_2 is $9 \cdot 6 \times 10^5$ dynes/cm., and for SO is $7 \cdot 8 \times 10^5$ dynes/cm.; since the heat of dissociation of each SO_2 bond is 248/2, the corresponding quantity for SO should, from the above, be approximately $124 \times 7 \cdot 8 / 9 \cdot 6 = 101$ kcal., and hence the experimental value again represents dissociation into one normal and one excited atom, possibly in this case a (^1D) O atom.

It was further observed that the force constants for the molecules CO, NO, OO were proportional to the heats of linking for these substances; the periodicity thus observed suggested the calculation from band spectra data of the heats of linking of a large number of non-polar compounds of the second and third

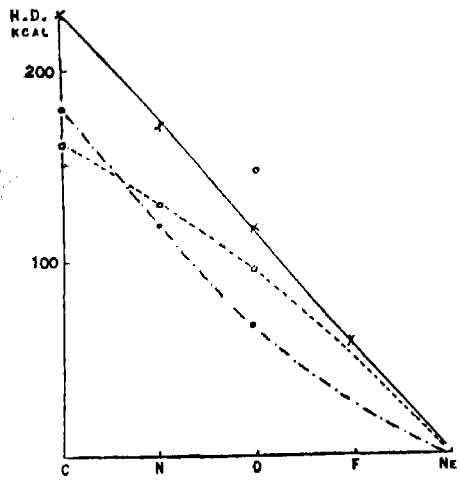


FIG. 1.—Heats of decomposition in second period. -x- oxide, -o- sulphide, -●- dioxides/2.

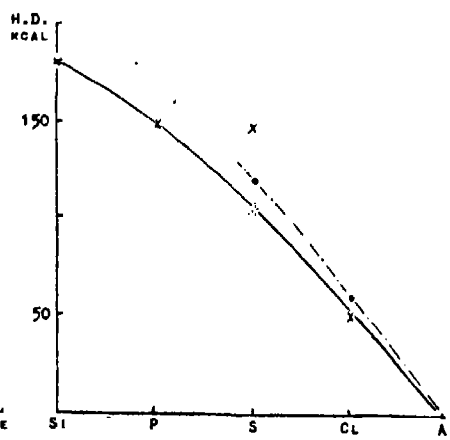


Fig. 2.—Heats of decomposition in third period. -x- oxides, -●- dioxides/2.

periods of the table: many of these, such, for example, as NS, have become only very recently available. Some of the data are given in Figs. 1 and 2, and it will be seen that the values lie on regular curves which are very nearly straight lines, the heat of formation of the inactive gas compound being taken as zero. If SO is taken either as the sulphide of oxygen in the second period or as the oxide of sulphur in the third period, it will be seen that the previously accepted value lies high above the curve in each case, interpolation giving the calculated value of *c.* 100 kcal. The method has been extended to the diatomic molecules of the elements and the nitrogen and carbon compounds; the regular nature of the curve holds in all cases. A number of interesting consequences arise and will be expounded in a subsequent paper: it will suffice to mention two of them, taken from the nitrides of the second period: (1) the experimental value for CN lies some 1·6 volts below the curve, suggesting decomposition into normal N and C atoms, C (^3P) being below C (^5S) by this amount; and (2) half the heat of formation of N_2O lies midway between NN and ON, confirming the structure NNO and not NON for this substance.

C. R. BAILEY.

The Sir William Ramsay Laboratories of Inorganic and Physical Chemistry, University College, London,
July 1.

[1] *Proc. Roy. Soc.*, A, **132**, 236; 1931.

Micro-Analysis of Gases

KROGH'S micro-analysis method as originally described,[1] for small bubbles of from 50 to 100 cubic millimetres and containing oxygen, carbon dioxide, and nitrogen, is limited to bubbles which have been in contact with a fluid, because the lower cup of the micro-apparatus must be filled with some of the same fluid with which the gas bubble has been in equilibrium, otherwise the gas bubble will lose some gas, particularly carbon dioxide, which is so soluble in most fluids.

I have been attempting to modify this method so that gas tensions in any small bubble from an animal's tissues may be estimated, that is, also in bubbles which have not been in contact with excess of fluid. The problem was investigated using a freshly prepared solution of 80 per cent glycerol and 20 per cent distilled water to fill the cup, capillary, etc., of the micro-apparatus. The coefficient of solubility of nitrogen in glycerol is too low for measurement, and those for oxygen and carbon dioxide are too low to cause any appreciable absorption under the present conditions. The addition of the small amount of water to the glycerol enables the bubble to be moved up and down easily in the graduated capillary of the apparatus without breaking up.

A small gas bubble is injected anywhere in the body cavities, tubes, or tissues and after some hours' interval it is withdrawn by means of a standard 1 c.c. syringe fitted with a very fine needle, the dead-space of which is filled with the above glycerol solution. The bubble is then carefully transferred to the cup of the apparatus, which has been previously filled with the same solution. The remainder of the technique for analysis of carbon dioxide and oxygen is as described by Krogh. I have been able to analyse mixtures, of from 0 to 15 per cent carbon dioxide and from 0 to 20 per cent oxygen with the remainder nitrogen, in gas bubbles (50-100 c.mm.) using the micro-apparatus in this way; the gas tensions obtained agree, within 2-3 mm. Hg, with those obtained from analyses of 10 c.c. of gas in the ordinary Haldane analyser. Carbon dioxide and oxygen tensions in the bladder and uterus have been estimated with the above accuracy using this modification of the micro-method.

I have diminished the risk of entry of small bubbles of outside air into the lower cup during the manipulations by attaching a glass tube 8 cm. in length to its lower end by means of a short piece of rubber tubing. The lower end of the glass tube is bent slightly, and its opening is so cut that the under edge projects beyond the upper; the whole tube is kept filled with the same fluids as used for the lower cup.

J. ARGYLL CAMPBELL.

National Institute for Medical Research, Hampstead, N.W.3,
July 15.

[1] *Skand. Arch. f. Physiol.*, **20**, 279; 1908.

Raman Spectrum and Molecular Structure of Ozone

AN attempt has been made to find the Raman spectrum of ozone, using a 30 per cent solution of ozone in liquid oxygen and a mercury arc as the exciting light. The solution is a dark purple in colour and absorbs the mercury line at 4358 A. quite considerably. The mercury line at 4046 A., however, is scattered fairly strongly, but it has no strong Raman companions. There is an extremely weak doublet corresponding to a mean frequency shift of 1280 cm.$^{-1}$, but no other Raman lines could be observed even with exposures lasting 80 hours. The spectrograph used was not particularly fast, but photographs of the weak oxygen line at 1550 cm.$^{-1}$ from 4046 A. could be obtained in 10 hours.

The conventional representation of the ozone molecule is an arrangement of the oxygen atoms at the corners of an equilateral triangle. More recently a straight line model has been proposed.[1] The weakness of the Raman spectrum is important as evidence against any simple symmetrical structure of the ozone molecule. On Placzek's theory,[2] either of these models would give rise to at least one strong Raman line, since each has a symmetrical mode of vibration in which the polarisability varies sharply with changes in the associated normal co-ordinate. The conclusion that the form of the ozone molecule is triangular but not equilateral is supported by the results of investigations of the infra-red absorption bands of gaseous ozone under high dispersion which one of us (S. L. G.) is carrying on at present.

A full account of the latter investigations, along with a discussion of the form of the ozone molecule, will be published later.

G. B. B. M. SUTHERLAND.
S. L. GERHARD.

University of Michigan,
Ann Arbor,
June 29.

[1] Jakowleva and Kondratjew, *Phys. Rev.*, **39**, 533; 1932.
[2] Placzek, *Z. Physik*, **70**, 84; 1931.

Post-Dissociation Radiation from Sulphur Trioxide

ACCORDING to Franck's theory of photodissociation of the halogens, the effect of light absorption is to split I_2 into a normal iodine ($^2P_{\frac{3}{2}}$) and an excited iodine ($^2P_{\frac{1}{2}}$). No direct proof has yet been forthcoming that the metastable atoms are actually produced in the reaction.

A direct proof of the production of the $^2P_{\frac{1}{2}}$-atoms may be attempted in various ways. The most convincing proof will be afforded if it can be shown that the illuminated I_2 vapour gives out radiations of frequency $\nu = {}^2P_{\frac{3}{2}} - {}^2P_{\frac{1}{2}}$ at very low pressures. The low pressure would avoid collisions of the second kind, and thus the energy of excitation would be available again as a radiation. The experiment with I_2 would be difficult, as the line $\nu = {}^2P_{\frac{3}{2}} - {}^2P_{\frac{1}{2}}$ would be in the far infra-red. But there is promise of better success with photodissociation of SO_3.

It was recently postulated by me[1] that SO_3, on absorption of light of wave-length less than λ2300 A., decomposes into SO_2 and O ($^1D_2$). If the assumptions are correct, it would mean that by irradiating SO_3 with light of wave-length below λ2300, we would obtain oxygen atoms in the $^1D_2$-state. If we prevent collisions of the second kind by sufficiently lowering the pressure, the forbidden transition line of the oxygen atom O ($^3P_1 - {}^1D_2$), corresponding to the wave-length λ6364, would be expected from the SO_3 gas.[2]

After repeated trials a weak line has been obtained by illuminating for 50 hours a 100 cm. long column of SO_3 gas at a pressure of less than 1 mm. The illuminating source was the condensed spark lines of cadmium below λ2300. The wave-length of the observed line is the same as that of the O ($^3P_1 - {}^1D_2$) line, that is, λ6364.

ARUN. K. DUTTA.

Physics Department,
University of Allahabad, July 2.

[1] Dutta, "On the Absorption Spectrum of SO_3, etc.", communicated to *Proc. Roy. Soc.*
[2] Paschen, *Z. Physik*, **65**, 1; 1930.

A New Photoelectric Phenomenon

METAL films are subjected to the passage of electric current and exposed to light, which is interrupted with acoustic frequency by a rotating disc with holes. A thermionic amplifier permits a sound of the same frequency to be heard in a telephone when silver, gold, platinum, and tin are tested: aluminium and zinc give no effect.

A copper wheel with sinusoidal border, carrying as many teeth as the holes of the disc, turns jointly with it. Against the border of the wheel, a jet of mercury is directed, the length of which pulsates with the same period as the light. The jet is included in the circuit of the metal film. By regulating the position of the jet and the resistances of the circuit, the sound at the telephone may be extinguished. It may, therefore, be concluded that:

1. The metals examined *increase* in resistance under action of the light. For silver, the maximum effect seems to be obtained in the ultra-violet region; for the other elements, such a maximum is displaced towards the visible spectrum and perhaps the infra-red.
2. The increase in resistance is of the order of 1/10,000 to 1/100,000 of the resistance of the metal.

The same experiments have been repeated by plunging the metal films into a current of water, but no sensible variation in the intensity of the effect has been noted. The effect appears, therefore, to result from direct action of light on electrical conductivity.

Q. MAJORANA.

Institute of Physics,
University of Bologna,
July 9.

Origin of the Coronal Lines

IN a recent communication in these columns, Frerichs[1] has criticised de Bruin's classification of the strongest visible lines of the corona. In the same issue of NATURE, Dingle[2] also has criticised the identification of these lines. In each of these communications the authors failed to direct attention to another very strong objection to de Bruin's conclusion that the green auroral line and the green coronal line originate on the same metastable level of oxygen, the $^1S_0$ level. Since no trace of the green auroral line has ever been observed in the corona, and as no one has ever observed the green coronal line in either the aurora or in laboratory discharges in which the green auroral line was very intense, it is extremely difficult to see how the two lines can originate on the same initial state. If the two lines did originate on the same initial state, their relative intensities should be the same in both the aurora and the corona spectra. One might be able to account for a slight difference in relative intensities by postulating reabsorption of one of the lines, but it seems impossible to explain the profound difference which would follow from de Bruin's classification of the green coronal line.

JOSEPH KAPLAN.

University of California at Los Angeles,
July 2.

[1] NATURE, **129**, 901; 1932.
[2] NATURE, **129**, 902; 1932.

Sex-Differences in Crossing-over and Chiasma-Frequency in the Mouse

HALDANE (1922) stated the law, based on the observations of many researchers, that if crossing-over is reduced or entirely suppressed, this occurs in the heterozygous sex. Reduction of crossing-over in the heterogametic sex is found in the Tettigidæ, *Gammarus*, *Mus musculus*, and *Mus norvegicus*, and complete suppression of crossing-over in the male of the Drosophilæ and in the heterogametic female of *Bombyx*.

Recent investigations on meiosis in diploids and polyploids have dispelled many difficulties and have increased our understanding of genetical segregation. Darlington (1930), adopting Janssens' (1924) partial chiasmatype hypothesis, states that "a chiasma is constituted by genetical crossing over between two of the four chromatids taking part in it, and association at diplotene is between chromatids derived from the same chromosome". Here Darlington is in direct opposition to the 'classical' theory held by Wenrich (1917), Wilson (1925), Sax (1930) *et alii*. Darlington's view assumes a close parallelism between chiasma formation and crossing-over. One important theoretical objection to Darlington's hypothesis, as he himself stated (1931), was that "the difference in crossing-over between the sexes has not been paralleled by the direct observation of differences in chiasma formation".

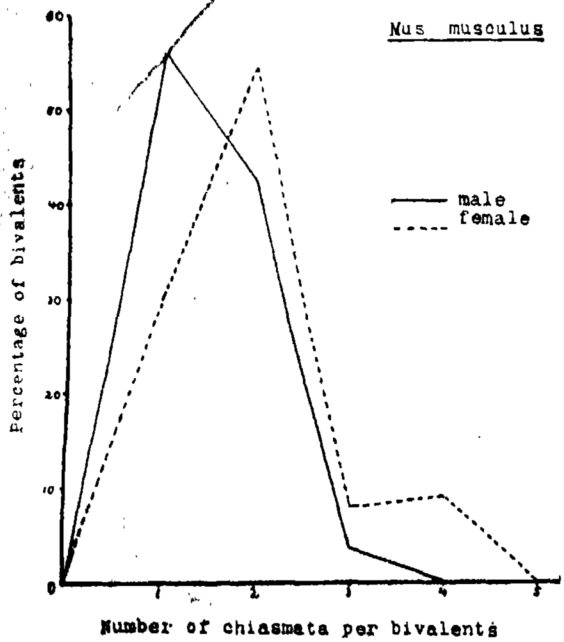


FIG. 1.—Graph illustrating the chiasma frequency of male and female *Mus musculus* at metaphase.

It was thought desirable to examine chiasma frequency in male and female mice, in view of the fact that it has been shown that linkage between the albino and pink-eye factors in *Mus* is closer in the heterogametic male, that is, the crossing-over value is lower in this sex than in the female. From these genetical data a difference in the chiasma frequency in the two sexes would be predicted on the chiasma-type hypothesis, whereas if any correlation between differences in chiasma frequencies and crossing-over values is to be expected on the alternative hypothesis that crossing-over is caused by the breaking of chiasma, the sex with increased crossing-over should have a reduced chiasma frequency.

Observations on chromosome behaviour during meiosis in *Mus* have revealed differences in the chiasma frequencies and terminalisation coefficients in the two sexes. In the female at metaphase the chiasma fre-

CROSSING-OVER VALUES BETWEEN ALBINISM AND PINK-EYE IN *Mus musculus*

(Castle and Wachter, 1924)

	Gametes tested.	Cross-over Gametes.	Crossing-over Value.	Authors.
Female	2789	444	15·92 ± 0·9	Dunn, 1920
Male .	3683	503	13·65 ± 0·78	,,
Female	556	106	19·06 ± 2·02	Castle and Wachter, 1924
Male .	3374	462	13·89 ± 0·82	,,
Total				
Female	3345	550	16·44 ± 0·82	
Male .	7057	965	13·77 ± 0·57	

CHIASMA FREQUENCY AND TERMINALISATION COEFFICIENTS DURING FIRST METAPHASE IN *Mus musculus*

	Total No. of Bivalents.	Total No. of Chiasm.	Total No. of Term. Chiasm.	Mean Chiasm. Frequency.	Term. Coeff.
Female	100	197	86	1·9	0·43
Male .	100	147	100	1·4	0·67

quency per bivalent is 1·9 and terminalisation coefficient 0·43, whereas in the male it is 1·4 and 0·67. Since the animals examined had the same genetic constitution, the differences in chiasma frequency could not be due to genic dissimilarity.

These observations strongly support the partial chiasmatype hypothesis of crossing-over.

P. CH. KOLLER.

Institute of Animal Genetics,
University of Edinburgh.

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Measurement of the Electricity liberated during Downgrade Reactions of Organic Compounds

MR. WOLFENDEN'S letter on this subject [1] has, I regret, only recently come to my notice. I had thought that our correspondence had cleared up the points at issue. I would point out that the liberation of electricity by the action of micro-organisms during the downgrade reactions of organic compounds, as set forth in my paper,[2] has been confirmed by Elema,[3] Gillespie,[4] Hewitt,[5] and others, and my results are quoted as the starting-point for the investigations of oxidation-reduction potentials in biochemistry and bacteriology. In this paper it was emphasised that the electrical effects only occurred under conditions favourable to the growth of the micro-organisms in question.

It is well known that aqueous solutions of pure sucrose are unsuitable for the growth of yeast, and that little or no fermentation takes place when these culture media are employed. When, however, sucrose is used in Pasteur's solution, fermentation proceeds rapidly.

In my experiments I have found that sucrose and the highly refined cane sugars are unfermentable with

yeast and give no electrical response.[6, 7] On the contrary, the unrefined sugars, such as Barbadoes, give a vigorous fermentation and corresponding electrical response. It is not therefore surprising that Mr. Wolfenden's experiments conducted with pure sucrose gave negative results, and the discrepancy between us may thus be explained.

In the two sets of experimental conditions Mr. Wolfenden used pure sucrose while I used unrefined sugar, and I cannot agree that "it seems unlikely that the impurities could play a decisive part", as they evidently promote yeast-sugar fermentation and thus constitute a decisive factor in the electrical response.

M. C. POTTER.

Corley Croft,
New Milton, Hants,
July 11.

[1] Wolfenden, J. H., NATURE, **128**, 69, July 11, 1931.
[2] *Proc. Roy. Soc.*, B, **84**; 1911.
[3] Elema, B., "De bepaling van de Oxydatie-Reductiepotentiaal in Bacteriencultures en hare beteekenis voor de Stofwisseling". Delft, 1932.
[4] Gillespie, L. J., "Reduction Potentials of Bacterial Cultures and of Water-Logged Soils", *Soil Science*, **9**; 1920.
[5] Hewitt, L. F., "Oxidation-Reduction Potentials in Bacteriology and Biochemistry". Publication of the London County Council, 1930.
[6] Potter, M. C., "Measurement of the Electricity liberated during the Downgrade Reactions of Organic Compounds", NATURE, **127**, 554, April 11, 1931.
[7] Potter, M. C., "A Method of Measuring the Electricity produced during the Decomposition of Organic Compounds", *Zentralb. Bakteriologie*, Abtl. 2, Bd. 84; 1931.

Hydrolysis in Green Plants by Moonlight

IN view of the recent interesting discussion on 'Lunar Periodicity in Organisms', which has appeared in these columns,[1] some very simple experiments, carried out in South Africa in the grounds of Huguenot University College, would appear to throw some light on the subject.

On a bright moonlight evening, about 10.30 P.M., on the 9th day of the moon, that is, near the time of maximum polarisation, I noticed a very sharp shadow cast by a vine leaf on the one beneath it, the tip being very brightly illuminated. The lower leaf was picked

FIG. 1.—Hydrolysis of starch by exposure to moonlight of lobes *F*, *E* of a vine-leaf.

and quickly plunged into 95 per cent alcohol. On staining with iodine, a remarkable disappearance of starch was found to have occurred in the portion irradiated by the moonlight (Fig. 1, *E* and *F*), while the basal portion *ABCD* in shadow still retained its starch.

Similar results had previously been found on exposing leaves of spinach and *Tropæolum* to moonlight, a portion of the leaf having been covered by cardboard or tinfoil. The exposed part of the leaf showed distinct hydrolysis, while the starch remained in the covered part.

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[1] See NATURE, **130**, 23,
[2] NATURE, **111**, 49, Jan.
[3] *Bot. Gaz.*, **90**, 412, Dec. ...

Filtration of ...

FOLLOWING upon the publ... letter from Mr. MacClement an... upon the above subject,[1] it ma... cording the results of some si... direction. During the past nine m... filtering two potato mosaic viruses,... means of the same collodion membr... developed by W. J. Elford. This wo... carried out at the Molteno Institute at ... under the direction of Prof. D. Keilin, to wh... deeply indebted. I wish also to express my th... Dr. W. J. Elford for much assistance willingly give...

Before attempting to filter these two potato viruses through the collodion membranes, some preliminary filtration work was carried out with Pasteur-Chamberland candles. These experiments showed that while the *X* virus was filterable through an L_3 and occasionally an L_5 candle, the virus *Y* would not pass an L_1 candle. The experiments on filtration through the collodion membranes, while admittedly preliminary, showed that *both* viruses would pass a membrane of approximate pore size 0·35μ, and that both are held back by membranes of 0·15μ. This is a parallel case to that quoted by Messrs. MacClement and Henderson Smith, where Dr. Hamilton's virus would not pass an L_3 candle but would pass a membrane of 0·30μ pore size.

The inability of the *Y* virus to pass the L_1 candle is obviously not directly connected with the porosity of the candle or the size of the virus particle, but in all probability it is due to adsorption of the virus by the candle. I have found that if the virus complex, $X + Y$, is merely passed through a kieselguhr bed in a Buchner funnel, the filtrate invariably contains a 'pure culture' of the *X* virus, the *Y* being completely adsorbed to the kieselguhr; this offers a ready means of separating out a complex of these two viruses.

KENNETH M. SMITH.

Molteno Institute and
Potato Virus Research Institute,
School of Agriculture, Cambridge,
July 25.

[1] NATURE, **130**, 129, July 23, 1932.
[2] *Proc. Roy. Soc.*, B, **109**, 251-267; 1931.

Production of Microscopic Test-Rulings

IN NATURE of Sept. 19, 1931, under "Birthdays and Research Centres", I claimed that microscopic test-rulings up to 250,000 lines per inch had been produced in my laboratory.

Lately, for various reasons, I found it necessary to make a personal investigation into this claim, and I regret that I have been unable to find any evidence that rulings beyond 120,000 lines per inch have been produced here.

THOMAS R. LYLE.

Lisbuoy, Irving Road,
Toorak, Melbourne,
June 15.

·search Items

onstration .nd in parti- yses of pollen orges Dubois in Owing in a great itman, it has been portion in which the ı a turbary gives an or of the forest in that ary was being formed. of this nature have been ı, and eastern Europe; but ate in regard to the British m, and France. Applying the ication to the turbaries, it is ng the percentages of the various at stages, to arrive, through inference minant character of the forest trees, at climate at periods which can be equated er's scheme of chronology. Owing, how- ie distribution in time and space of climatic ns favourable to the formation of turbaries, post-Mousterian times that the method is more particularly applicable, while the most exact results refer to the epipalæolithic, neolithic, and metal ages. The results for various areas are summarised, and certain reservations made in regard to the quaternary period, though a post-glacial optimum during the neolithic is confirmed.

Indian String-Games.—Dr. James Hornell has published a number of string-figures from Gujarat and Kathiawar (*Mem. Asiatic Soc. Bengal*, vol. 11, No. 4). In his introductory remarks, he points out that this is the first successful attempt to collect 'cat's cradles' from Indian sources, and that only two had previously been published. It is surprising to find that none of the collection is of any complete animal or flowering plant, though this may be due to the fact that the great majority of informants were town-dwellers. The figures are mostly taken from the common objects of life: scissors, a saw, a mirror, a lock and key, a betel plate, handcuffs, etc. Three figures represent fruits, two a bird's feet, and one the nest of a crane. Mythological subjects are not represented. With the exception of the cosmopolitan Eurasian cat's cradle, nine of the ten games found outside India are common to India and Africa. The tenth game, the 'crane's nest', is also found in Africa, but is worked out by different moves. This common distribution emphasises the long connexion of Indians with Africa, and in particular, that of the traders and sailors of Gujarat and Kathiawar with East Africa, through a trade which goes back fully two thousand years. This is undoubtedly the main factor in this remarkable community of string-games. It is urgently necessary that ethnologists should collect the games in inland regions and among hill-tribes, to determine how far the games now described are indigenous to India and how far borrowed from African sources.

Rainfall and the Distribution of Birds.—A study of the birds of south-western Africa, made during an expedition lasting for two and a half months in 1930, leads Baron Rodolphe Meyer de Schauensee to the conclusion that the distribution of the birds in the region is governed largely by rainfall; altitude seems scarcely to play any part as a barrier (*Proc. Acad. Nat. Sci. Philadelphia*, vol. 84, May 1932, pp. 145-202). The region investigated comprises three areas delimited by rainfall averages of 0-10 in., 10-20 in., and 20-40 in. A striking example of the relation between this factor and the presence of a geographical race occurs in the case of *Saxicola torquata*. The race *salax* was first described from the Gaboon, but de Schauensee found it near the Victoria Falls—apparently a case of discontinuous distribution, for the intermediate region of Central Angola contains the race *stonei*. The explanation is that *salax* follows the rainfall region of 20-40 in. around the area occupied by *stonei*, so that the former appears quite naturally to the north and to the south of the latter race. Other striking examples are given, and although the expedition was too short to make the observations adequate (558 birds were collected, representing 254 species and subspecies), the seeming significance of the association and the fact that it explains some otherwise inexplicable problems of distribution suggest that it well deserves further testing.

The Arachnid Order Chelonethida.—Under the foregoing title, Dr. J. C. Chamberlain has contributed an extensive memoir of 284 pp. which forms No. I. of volume 7 of the Biological Series published by the Stanford University, California (1931). The Chelonethida or pseudoscorpions, as they are more familiarly termed, are dealt with from two points of view, namely, morphological and taxonomic. The morphological section of Dr. Chamberlain's work provides the most complete account available of the exoskeletal parts, and is accompanied by a wealth of clear text-figures. There is a full discussion of range of form and structure within the order, and full use is made of the morphological data thus brought together in dealing with the taxonomy of the group. As the result of these studies, the author has completely revised and reorganised the systematics of the group. Older and inadequate systems of classification have been largely discarded and a new taxonomy given in their place. The author has found it necessary to name about fifty new genera and one hundred and fifty, or more, new species. These, however, are all described in papers now in course of publication elsewhere, with the result that the present memoir is largely freed from the mass of purely descriptive matter, and is directed more especially to general classification. The work is one which students of the Arachnida will welcome, and its utility is enhanced by a bibliography listing some 311 titles and by full indexes to both text and illustrations.

Vitamins and Fungi.—Most of the work on vitamins has been performed on higher animals with the view of growth stimulation, but Y. Tochinai and M. Terui, two members of Hokkaido Imperial University, Japan, have studied the effects of vitamin A on various fungi ("Studies on the Effects of Fat Soluble Vitamin upon the Growth of some Parasitic Fungi", *J. Fac. Agri.*, Hokkaido Imp. Univ., Sapporo, Japan, vol. 32, pt. 3, pp. 71-107; 1932). The fungi *Helminthosporium turcicum* and *H. Oryzæ* were both retarded in growth by high concentrations of vitamin A, though the latter fungus was stimulated slightly by low concentrations of the vitamin. *Gibberella Fujikuroi* reacted like *H. Oryzæ*, whilst *Colletotrichum lindemuthianum* was similar to *H. turcicum*, being inhibited by high or low concentrations of vitamin A. Olive oil was the solvent for the growth-promoting substance, so parallel cultures with the oil alone were inoculated with the fungi in order to be sure that the observed effects were due to the vitamin. Whilst *H. turcicum* and *G. Fujikuroi* were indifferent to olive oil, the other two fungi were stimulated by it, though not sufficiently to mask the effects of the vitamin A.

The Permian Yellow Sands.—Dr. M. B. Hodge has made a detailed investigation of the Yellow Sands of north-east England (*Proc. Univ. Durham Phil. Soc.*, **8** (5), 410-458; 1932). Elutriation shows that there are two dominant grades, one between 0·05 mm. and 0·15 mm., the other between 0·6 mm. and 0·8 mm. This is taken to indicate æolian transportation of the grains. The heavy minerals agree in species and type with those of the Scottish Carboniferous rocks. The quartz grains are frosted and the larger ones well rounded. The inclusions indicate a dual granitic and metamorphic source. It is concluded that the Yellow Sands were mainly a deposit of sand on the shore of the Permian sea, the material being derived partly from Carboniferous sandstones near by and partly from a crystalline area to the north. While the Sands were being laid down on the shores and along the adjoining coastal strip, the Marl Slate was accumulating as a calcareous mud in lagoons fringing the shores. With the sinking of the coast the lagoons were gradually invaded by the sea, from which the Lower Magnesian Limestone was deposited. While these changes were in progress the æolian sands would occasionally be blown into the lagoons, giving rise to the intercalations of sand with shale and limestone now found. The three deposits seem to be in part contemporaneous, although the general succession is, as usually stated, from Yellow Sands through Marl Slate to Lower Limestone.

Petroleum Genesis and Volcanic Ash.—For some time past it has been common knowledge that the production of artificial petroleum from animal or vegetable oils by distilling them with different adsorbent materials, for example, clay, charcoal, calcium carbonate, diatomaceous earth, has been achieved. A more sharply focused problem in this connexion has recently engaged the attention of Japanese investigators, who took advantage of the volcanic eruption of Komagadake, Hokkaido, in 1929, and secured from the Earthquake Research Institute some of the ash ejected. Using this material as the adsorbent, extensive physical and chemical tests were carried out with different oils, partly to ascertain the action of the ash thereon, also to see whether the results threw any light on the origin of petroleum in the Japanese oilfield (T. Terada, M. Hirata, and T. Utigasaki, *Scientific Papers*, Institute of Physical and Chemical Research, Komagome, Hongo, Tokyo, No. 343, 1932). The results show that the action of this ash on the oils tried is to produce a distillate closely resembling ordinary kerosene so far as physical properties are concerned, though differing from the petroleum product in chemical behaviour, notably in its reaction to strong sulphuric acid, which points to the presence of a predominance of unsaturated compounds. Notwithstanding this, the authors claim that there is decided possibility that much of the Japanese oil has originated from animal or vegetable oily matter buried beneath volcanic ash.

International Standards.—The degree of accuracy which has now been secured in the international measurement of capacitances is well brought out in a communication by Mr. H. L. Curtis and Miss C. M. Sparks, of the U.S. Bureau of Standards, and Messrs. Hartshorn and N. F. Astbury, of the National Physical Laboratory, to the April issue of the *Journal of Research* of the Bureau. The capacitance of a subdivided mica-tinfoil condenser of 1 microfarad was measured alternately at Washington and at Teddington, at the former by comparison with a standard air condenser the capacitance of which was measured in terms of resistance and time by Maxwell's method, at the latter by comparison with the standards of resistance and mut. capaci Washin 1·0019, 1 while at Te The unit of therefore iden thousand.

Measurements ... **Sweden.**—A recent *Circular* (March 25) co at Abisko on the intens A. Corlin. Both a Kolhö a standard Steinke chamb at a number of other places the data from different parts used. The results obtained are tail, the paper being chiefly devo the methods of observation and of but several points of much interest. Perhaps the most significant is that, a daily variations, the intensity of the radi closely constant at this high latitude (68 correcting for changes in the barometer, as found farther south. In the Abisko obse made to the north of the arctic circle, the every expectation that meteorological effects an an influence of the aurora, if these existed, would be detected. The rate of ionisation under standard conditions is given as nearly 2·78 *J*. Another point, which might have been anticipated, but which it is, nevertheless, satisfactory to have demonstrated directly, is that humidity, as well as temperature, has no perceptible direct influence upon the penetrating radiation, and that the correlation between ionisation on one hand and humidity and temperature on the other is wholly due to the existence of a correlation between ionisation and air pressure. Publication of the full record of this work will be awaited with much interest.

Infra-Red Photomicrography.—The recent placing of infra-red sensitive plates upon the market has stimulated many inquiries as to possible new applications of photographic methods. In a communication to the Eighth International Congress of Scientific and Applied Photography held at Dresden in August 1931, Prof. Köhler and Dr. Paul Kraft of Jena described results obtained with infra-red plates in photomicrography. Three typical examples of objects opaque to visible light but transparent to infra-red rays of about 8000 A. are shown in their paper; these are woollen threads dyed black, the head of a flea, and a fossil from coal. In each example a very great improvement in the detail of structure revealed is evident where infra-red sensitive plates were used. The magnification employed ranged from 20 to 76 diameters.

Corrosion Resistivity of Metals.—Many methods have been devised for following the velocity of metallic corrosion; the loss of weight, the loss of strength, the loss of conductivity in the metal, the evolution of hydrogen, the absorption of oxygen, and even the evolution of heat, have all served as measures of corrosion under different conditions. Lately, Mr. E. W. Zehnowitzer, of the Institute of Metals, Leningrad, has used conductivity changes in the *liquid* for the same purpose, introducing into his corrosion vessel two platinum electrodes, connected to a Wheatstone bridge in the familiar manner. His results, communicated in a letter to the Editor of NATURE, show that during the corrosion of zinc by sulphuric acid the conductivity of the liquid steadily falls, whilst during attack by distilled water it rises; the

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$-\log f = \log (S/S_0) - \log f_0$, the
ated by extrapolation to zero
plot of $\log (S/S_0)$ against some
he total concentration. A theoret-
r f, involving the distance of closest approach, a, of the ions, has been deduced by Debye and Hückel. Neumann (*J. Amer. Chem. Soc.*, June), by experiments on the solubilities of silver chloride in solutions of various sulphates and nitrates, finds marked deviations from the Debye-Hückel limiting law as well as from a first approximation formula, even at the lowest concentrations, in the case of sulphates and lanthanum nitrate. The sulphates of unsymmetric valency type exhibit deviations of fluctuating sign from the limiting law when the observed activity coefficient is plotted against the square root of the ionic strength. The symmetric sulphates show only one positive deviation, potassium and barium nitrates scarcely any. The extension of the Debye-Hückel equation due to Gronwall and La Mer (NATURE, **128**, 499; 1931) gives values of a in good agreement with experiment in the case of the symmetrical sulphates and nitrates, but does not explain the peculiar behaviour of the unsymmetrical valency type sulphates, except possibly as a first approximation.

Astronomical Topics

tion of Borrelly's Comet.—This comet was covered in 1905 and has been observed at every return since. Its period is so close to seven years that the conditions have been favourable for observation at all the returns. Two predictions of the conditions of this return were made: W. P. Henderson and J. D. McNeile (B.A.A. Handbook) gave Aug. 26·268 for the perihelion passage; M. Schaumasse (*U.A.I. Circ.* 365) gave Aug. 27·816. The truth appears to lie between them. The comet was detected by Prof. G. van Biesbroeck at Yerkes, July $30^d\ 9^h\ 6{\cdot}2^m$ U.T., the position being R.A. $5^h\ 31^m\ 54{\cdot}67^s$, N. Decl. 13° 2′ 13″ (equinox of 1932·0). The date of perihelion given by the R.A. is Aug. 26·690; the declination gives Aug. 27·171. The comet was of magnitude 12 at discovery; as it is approaching the earth until the end of the year it is likely to become brighter. The comet is a morning object in Gemini; the ephemeris in the B.A.A. Handbook will suffice for finding it. An ephemeris is also given there for Brooks's comet, which is likely to be found shortly; two independent computers, Mr. F. R. Cripps and Prof. Dubiago, both find Oct. 7·6 for the perihelion passage; the conditions this year are very favourable for observation, as the comet is in opposition when in perihelion.

Meteor Observations in New Zealand.—An article on meteors by R. A. McIntosh, of Auckland, New Zealand (*J. Roy. Ast. Soc. Canada*, May–June), is welcome since it shows that systematic observation of meteors is now carried on in those islands. For a long time the statistics were based solely on observations made in the northern hemisphere; obviously the inclusion of southern observations adds greatly to their value. When we walk beside a tram-line, more cars meet us than overtake us, since our motion shortens the interval in one case and lengthens it in the other. In the same way, more meteors meet the earth than overtake it. Now, these meteors that are meeting us come from the earth's apex, or point towards which it is moving in its annual revolution; this is a point in the ecliptic 90° behind the sun, which rises some six hours before the sun, or about midnight. Hence the 'meeting' meteors are chiefly visible after midnight, which explains the fact that more meteors are seen in the small hours than before midnight. The apex is at its farthest north in September, so we should expect a maximum of meteors in northern countries in that month; actually the diagram of Mr. McIntosh shows it in August, with a well-marked minimum in the spring; it is doubtless affected by the rich Perseid shower in that month. The diagram that he gives for the southern hemisphere does not show the seasonal effect so clearly; there is certainly no maximum about March, as we should expect; on the contrary, there is a succession of rich months from May to October, the cause for which is not clear. But the diagram of the numbers of meteors for different hours of the night agrees well with theory, and shows a maximum at 3 A.M. The slight falling off after that may be due to dawn, or to fewer watchers. Mr. McIntosh alludes to the effect of Jupiter's action in diverting the Leonid meteors so as to miss the earth in 1899; but he omits to note that the calculations of the B.A.A. Computing Section give hopes that this action may be reversed in 1932.

The Ritchey-Chrétien Reflecting Telescope.—The *Scientific American* for July contains an article by A. G. Ingalls on the improvements which M. Chrétien and Prof. Ritchey are carrying out in the design of the Cassegrain reflector. It is well known that star images in photographs taken with reflectors are generally good in the middle of the field but deteriorate greatly towards the edges of the plate, where large wings generally appear, making accurate determination of position or magnitude difficult. This is because the paraboloid form of the mirror gives good results for rays parallel to the axis, but not for oblique rays. The first improvement is to make the large mirror a hyperboloid instead of a paraboloid. The form of the secondary mirror is much more complicated; it is on the hyperboloid side of the paraboloid, but cannot be described by any simple name, since different zones are specially designed to give the best results. It is also proposed to use slightly concave plates, the curves being designed in conjunction with those of the mirrors. It is noted that the new reflectors are shorter and therefore lighter than the old, so that some of the extra cost of the mirrors is made up by the smaller dome. The article also mentions that Prof. Ritchey has designed new methods of guiding the telescope during exposures, which make the following simpler and more rapid. Two keys, one accelerating, the other retarding, are held in the hands, while an occulter, to cover the plate during moments of bad definition, is worked by the lips. The instrument now under construction has aperture 40 inches, but it is hoped to extend the method to much larger sizes; if so, the cellular type of mirror will probably be used.

Archæological Studies in

AN outstanding feature of the first International Congress of Prehistoric and Protohistoric Sciences held in London last week was afforded by the group of lectures which were delivered at the general meetings of the Congress held on the evenings of Aug. 2, 3, and 5, and on the morning of Aug. 6, to which the presidential address on the afternoon of Aug. 1, and the exhibition of British archæology in the field at the London Museum, to which reference was made in NATURE of Aug. 6, p. 196, had formed an appropriate introduction. While Sir Charles Peers, in his address on "The Beginnings of British Archeology", had traced the stages by which interest in the exploration of the past had attained the status of a scientific study, and the exhibition had given a practical demonstration of what is now being achieved in the field, Dr. Cyril Fox, Mr. E. T. Leeds, and Mr. T. D. Kendrick laid before their audiences the results of synthetic study of the facts most lately won in the field at three strategic points in the early history of the British Isles. The picture was completed on the morning of Aug. 6 by Mr. O. G. S. Crawford's account of Britain's achievement in the development of archæological discovery by photography from the air, which was so admirably illustrated by the photographs exhibited by the Ordnance Survey at the London Museum.

Sir Charles Peers, in his presidential address, while tracing the spirit of the archæologist back to the interest of primitive man in his predecessors, distinguished the latter as a hope for treasure, while around the great monuments of the past, which have never failed to arouse the attention of the living, has collected a mass of material, sometimes dignified by the name of folk-lore, which should not be overlooked. Early antiquaries explained prehistory in the light of history as known to them. When anything remarkable remained, the natural tendency was to ascribe it to the Romans. Camden, the learned forerunner of modern antiquaries, saw no reason to ascribe a date before the Roman occupation of Britain to any notable monument except Stonehenge—*insana substructio*. Aubrey, the Wiltshire squire, said Sir Charles, had the definite merit of setting down what he saw. In 1648 he was impressed by the absurdity of deriving such structures as Avebury from the classical tradition. He was persuaded that Stonehenge was a temple of the Druids. Then came William Stukely, a man gifted with a vivid imagination and an insatiable curiosity. "What is all learning", he said, "but a knowledge of antiquities?" Sir Charles then reviewed the work of Sir Richard Colt Hoare, whose book on the Wiltshire monuments, of which the first volume was published in 1810, was prefaced with the words, "we speak from facts not theory"; of William Smith, whose geological map of England demonstrated a succession of ruined worlds, opening the way to a new conception of the prehistory of man; and of John Frere, who attributed his palæolithic implements to a period "even beyond the present world"—the transition from ancient to modern archæology.

Dr. Cyril Fox, in his address on "The Personality of Britain", dealt with some of the fundamental principles of prehistory, demonstrating the bearing of climate and soil, and the resulting vegetable and animal life, on man and his history. As a whole, these represent man's environment and Britain's personality. The position of Britain, he said, adjacent to five hundred miles of European coast, renders the country liable to invasion, while its indented outline is convenient for invaders, and its estuaries and slow-moving rivers invite penetration. Of the three main routes fo. Channel, o. that by the narrow gorge, higher; but wh. Britain to its no. concentrate on Ke.

Dr. Fox then proc. division of the island . Clyde isthmus into a w. eastern lowland zone led . on the east, which was ea. while in the highland zone . the same way the fertile lowla. populations, while north of the the Highlands tended to devel. Influences from Ireland were usua. highland zone. The lands washed b. thus tended to develop cultural unity. way, soil was the controlling factor in . tribution and elevation in the highland, as . not stand the cold. The most complete man. of any primitive culture entering eastern or so. Britain from the Continent focused in the Salisbu. Plain region, but as civilisation developed, overseas trade moved in the direction of the Thames estuary and a change came in the type of soil and country desired by the inhabitants. Hence the progress from subjection to environment to control of environment, from barbarism to civilisation, is expressed by the utilisation of oak forests and the substitution of arable fields.

In "Celtic Art in Britain", Mr. E. T. Leeds sought to trace the origins and development of an artistic epoch which lasted from its beginnings in La Tène style down to the eleventh century of our era. It was first implanted on the south coast, probably in the late fifth or fourth century B.C., and taking root firmly in the third century B.C., when it began to discar. the naturalistic tendencies of the parent continenta. school in favour of geometrical arrangements of curving lines. This school found its most brilliant expression in a western school, the districts first occupied by iron age peoples, which permeated the eastern Midlands and spread to Yorkshire and beyond. A period of decadence ensued. While intruding Belgic tribes developed *champlevé* enamelling, the British craftsman attempted novel designs by "breaking the back of the curve".

Before the Roman conquest, southern Britain was falling under the influence of continental mass production. There is a loss of originality and an increase of formalism. Small geometrical designs in enamel aim at a jewelled effect: on the periphery of the Roman occupation, however, Celtic art survived and the Celtic genius adapted classical models as in the Æsica brooch. A fresh burst of activity set in as seen in the enamelled escutcheons of the Winchester and other bowls, a group confined to the east of the Fosse Way. The outcome was the trumpet scrolls beloved of the Celt with his feeling for the curving line. This renaissance in southern England in the sixth and seventh centuries, in conjunction with certain zoomorphic designs, provides the key to the sudden appearance in Ireland at the close of the seventh century of such masterpieces as the Book of Durrow, unheralded by anything in the previous art history of the island.

Mr. T. D. Kendrick, in "The Crafts in Ancient Britain", dealt with the difficult but none the less interesting period of the Early Dark Ages, holding

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graves of his conquerors. Investigation of the chronological position of such material as the famous 'Kingston' brooch shows that it is more likely to be British than Jutish, as it has been regarded. There is a definite probability of some progress in the task of sorting out minor Arthurian antiquities from the 'Anglo-Saxon' cases of the museums.

Rimu or New Zealand Red-Pine

...ssibility of obtaining ...rom the Empire is so ...present day, a leaflet by ...erties and Uses of Rimu" ..., No. 17, Nov. 1931) merits ...nor states that rimu (*Dacry-* ...pplies rank as the most im- New Zealand. It is milled and ...timber-producing district in the ...he principal building timber in the ...s employed in almost every local wood- ...y, and in many is the chief timber used. ...nt time, practically the whole of the rimu ...is consumed locally, less than 3 per cent being ...d. The quantity milled annually exceeds that ...all other species combined, and during the year ...ding March 31, 1930, totalled 159,000,000 ft. Board Measure (B.M.), or 58 per cent of the total timber production of the Dominion. In 1920–1930 the annual cut of the species exceeded 140,000,000 ft. B.M., the peak production of 195,000,000 ft. B.M. in 1926 representing 55 per cent of the total timber produced that year. That the fellings are exceeding the annual increment or possibility is exemplified by the statement that a few years ago Auckland supplied a far larger proportion of the total cut than any of the other districts, but its accessible supplies have now dwindled, and Westland has taken the lead and is said to be likely to supply an increasing percentage in future years.

The first detailed statistics on the export of rimu ...ere collected in 1913, when 8,500,000 ft. B.M. were exported. In the War years the trade increased, and by 1918 the total exports had reached 30,000,000 ft. B.M. This was due to the difficulty in obtaining supplies of North American and Scandinavian timber during the War years. With the drop in price of the foreign species at the end of the War, and low ocean freights, it was possible to land the foreign material cheaper in Australia than rimu. The exports of the latter to Australia had fallen to 4,000,000 ft. B.M. in 1925, and have remained at that figure ever since. Recent customs duties on foreign timber in Australia now permit rimu to compete successfully once more, and a recent survey has shown that 20,000,000 ft. B.M. of rimu could be used in Australia annually.

The leaflet is written from the marketing and manufacturing point of view. It is to be hoped that the Forest Department will bear in mind the great value to the country of this fine timber, and will take steps to see that its regeneration is undertaken, in order to perpetuate supplies.

The rimu is a fine forest tree, the height in the average commercial stand varying from 60 ft. to 120 ft. When mature, its trunk is long, straight, unbranched, and with little taper, carrying a comparatively open and irregular crown. From the remarkable weeping habit of its foliage it is the most easily recognised and best known of all New Zealand trees. The commercial bole usually varies from 40 ft. to 80 ft. in length. Its diameter, breast height, in mature stands varies from 2 ft. to 4 ft., although it is said that many of the trees at present converted range below the lower limit. In other words, as is invariably the case when primeval forests are lumbered, immature trees are being felled along with the mature ones. Occasionally trees up to 8 ft. diameter are encountered and milled. It might be suggested that a few stands of these fine old trees should be selected by Government and reserved to show future generations what the New Zealand soil is capable of producing.

Although the tree grows on flat, but not marshy, land, it favours undulating localities and hillsides, being found at all altitudes from sea-level up to 2500 ft. With the exception of the pure beech (*Nothofagus*) stands, rimu occurs in every major type of forest growth, and in the North Island it is an occasional associate of the kauri.

Mr. Ward gives interesting details on manufacture, seasoning, grading, the properties of the wood and durability, and adds notes on its utilisation by various industries.

Winter Climate of Greenland

IN a paper read to the Royal Geographical Society on April 18, by Mr. S. T. A. Mirrlees, new light is thrown on the winter climate of the interior of southern Greenland. Mr. Mirrlees pointed out that nearly all our knowledge of the climate of this region is based upon observations made on summer sledge journeys, supplemented by the observations made throughout the year at the various coast stations of the Danish Meteorological Service. Greenland lies to the north of the region of the world's most persistent cyclonic activity, but—if we accept as accurate the distribution of high and low pressure shown on the daily charts of the British Meteorological Office and similar older publications, such as those of the Danish Admiralty—is at all seasons liable to be invaded by the cyclonic depressions of the North Atlantic.

In a series of observations made every three hours between Sept. 8, 1930, and April 26, 1931, at about lat. 67° N., long. 41° W., at a height of about 8250 ft., by the British Arctic Air Route Expedition, his hypothesis is confirmed. The direct influence of the Atlantic depressions on the weather was found normally to be small, as is shown by the low figures for the monthly mean proportion of the sky covered by cloud, which varied from five-tenths in September to three-tenths in February. The mean for the whole period must therefore have been roughly comparable with the normal for the French Riviera. But there were some stormy periods and even gales, and the strongest winds showed no tendency to be more prevalent from the prevailing northerly direction of the wind than from other quarters; moreover, the characteristic changes of wind, pressure, and weather caused by the passage of the centre of a depression directly over or to the north of the place of observation were observed.

Very low temperatures had been expected, and were not wanting, for a reading of −59° F. was

catalytic action of the lime on the course of hydration.—**Urion**: Cyclopentenyl-alkylcarbinols and their dehydration products.—**Henri Erhart**: The soils of the Rhine terraces to the south of Alsace.—**Lefèvre**: The presence of peridinians in a fossil deposit at Barbadoes.—**Feng Yen-An**: The presence of centrosomes and of star-shaped forms in an angiosperm, *Lonicera alpigena*.—**Pierre Dangeard**: The vacuome of Algæ and its transmission by the zoospores.—**A. Guilliermond**: The structure of bacteria.—**Marcel Mirande**: The evolution of hydrocyanic acid by certain fungi.—**H. Heldt**: Aerial observations for the localisation of shoals of tunny fish and the possibility of the direct study of their migrations. From an aeroplane it is possible to discover the shoals of tunny and fix their size, position, and direction of movement.—**Mme. C. Vincent** and **J. Vial**: Researches on the yields of milk and of fat in human lactation.—**L. Bugnard** and **C. Soula**: Glycæmic equilibrium and digestive secretions.—**A. Gruvel**: Some observations concerning the large lake Amer (Suez Canal). A discussion of the effects of variations of salinity on animal life in the lake.—**Marcel Avel**: The regenerating power of the dorsal and ventral halves of the body wall, in the cephalic region, in *Lumbricus*.—**A. Dognon**: The biological action of monochromatic X-rays of different wave-lengths on the egg of *Ascaris megalocephala*. The action of the X-rays, in the case of the cell studied, diminishes suddenly at the wave-length 1·54 A., and then remains constant down to the shortest wave-length studied (0·7 A.).—**A.** and **R. Sartory**, **J. Meyer**, and **M. Antonioli**: The presence of a pigment resembling prodigiosine in *Actinomyces Allenbachii*. The colouring matter was isolated in crystals as chlorhydrate and perchlorate. Its chemical and physical properties, especially the spectroscopic analysis, closely resemble those of prodigiosine.—**A. Dorier**: The larvæ of *Parachordodes alpestris*.—**Ch. Joyeux** and **J. Piéri**: The rabbit as a reservoir of virus for exanthematic fever.

GENEVA

Society of Physics and Natural History, April 28.—**R. Wavre**: Extension of a theorem of Stokes relating to fluid stars. Generalising the classical theorem of Stokes and of Poincaré relating to planetary figures, the author shows that the attraction of a fluid star (or nebula) on other stars depends only on its total mass, its free surface, and superficial accelerations. The distribution of matter in the interior of the star is without influence.—**M. A. Schidlof**: (1) The evaluation of the difference between the masses of the α_1- and α-particles. The difference between the masses of these particles of a nucleus is evaluated by a method not making use of the Gamow-Condon-Gurney threshold maximum potential. For two different nuclei (Th^{232}, Pb^{208}) concordant values are obtained, which confirm the value previously deduced from the threshold theory.—(2) The arrest of the periodic systems of the atoms and the greatest electronic concentration of the nuclei. Utilising the value of the mass effect by the proton, calculated by considering the presence of the particles in atomic nuclei of the thorium series, the author has deduced from the condition of the possibility of equilibrium the upper limit of existing atomic numbers. The inequality utilised in this calculation also furnishes the upper limit of the electronic concentration of compound nuclei.—**E. Briner**, **J. Bron-Stalet**, and **H. Paillard**: Researches on the dehydration of phenol. Contribution to contact catalysis. The authors have studied the dehydration of phenol in the presence and absence of a catalyst. In the presence of thoria, the reaction takes place rapidly up to a transformation of 60-64 per cent of phenol into phenyl oxide. If the catalyst is absent, the dehydration of the phenol is very slow but complete.—**A. Naville**: The cytological bases of the theory of crossing over in the Diptera. The author shows that in *Calliphora erythrocephala* at the commencement of ovocytary evolution a series of premeiotic phases is observed, allowing a parasyndesis, and capable of explaining crossing over. In spermatogenesis, nothing similar is observed and the spermatocytes enter directly into diakinesis without undergoing premeiosis. If these results can be extended to other Diptera, they constitute a striking verification of the hypothesis of Morgan and Sturtevant on crossing over in *Drosophila*.—**E. Cherbuliez**, **E. Ehninger**, **K. Bernhard**: The multiplicity of principles in the croton seed. The authors have extracted from croton oil a substance which is a powerful vesicant but has no purgative effect, while the oil left after its removal retains its purgative properties. Hence there are at least two active substances in croton oil.

VIENNA

Academy of Sciences, April 28.—**Wolf Johannes Müller** and **W. Machu**: Theory of passivity phenomena. (15) The passivating action of oxide layers in the anodic passivation of iron in neutral sodium sulphate solution.—**Anton Kailan** and **Walter Haas**: Velocities of esterification of methyl and ethyl alcohols in acetic acid. The esterification constants are given for acetic acids containing different amounts of water and in presence and absence of hydrochloric acid.—**Franz Fuhrmann**: Studies on the biochemistry of luminous bacteria. (2) Influence of sugar, with sodium chloride, on the luminosity. Addition of glucose, fructose, or galactose to cultures of *Photobacillus radians* containing 0·5 or 0·25 M. sodium chloride usually effects no, or but slight, rise in the luminosity. During the early stages of growth, sucrose and lactose enhance the luminosity, and maltose in small proportions causes an increase, but in larger quantities a decrease.—**Friedrich Hopfner**: The fundamental equations of physical geodesy. Determination of the mean level of the earth's surface from gravitation values depends on combination of Bruns' theorem with the solution of a partial differential equation of the first order. Former known solutions of this problem differ only in form, being variants of the solution of the differential equation.—**Otto Fürth** and **Eduard Herbert Majer**: (1) Accumulation of carbohydrate in the liver of lard-fed rats. The formation of glycogen in the liver has been studied with rats fed on lard together with either crude fibre or the sodium salt of one of the organic acids formed during the digestion of fibre in the intestines. Glycogen is formed from beet-slices or fermentation lactic acid, but not from butyric, succinic, or valeric acid. These lower acids are either resorbed from the intestine and possibly used in building up fat, or assimilated by micro-organisms and used in the construction of body-substance.—(2) Phlorizin glycosuria of the pig.—**Gustav Götzinger** and **Helmut Becker**: New discoveries of fossils in the Wienerwald.—**Herbert Haberlandt**: Luminescence of fluorites. Some fluorites exhibit red fluorescence, but none of these shows rare-earth lines in the spectroscope. Many fluoresce after irradiation with β-γ-rays and some only after ignition and irradiation, whilst others display no fluorescence.—**Fritz Rieder** and **Elisabeth Rona**: Range of α-rays of actinium products. Investigation of the α-rays of RdAc reveals two prominent grou[illegible] with the ranges 4·7 cm. and 4·35 cm. respect[illegible] together with three other groups. Prep[illegible] AcX free from RdAc show groups [illegible] 4·1 cm., 4·3 cm., and 4·6 cm., an[illegible] (5·00 cm. and 5·40 cm.). Ac[illegible]

a fine structure, as it gives, besides the known group of 6·47 cm. range, two faint groups of 6·35 cm. and 6·60 cm. range.—**Rudolf Leutner**: Velocity of hydrolysis of cyclic acetals (1).—**Konrad Funke**: Perylene and its derivatives. (35) Diaminoperylene-3: 10-quinone.

May 6.—**Karl Brunner** and **H. Moser**: 5-Ethoxy-indolinone.—**Arthur Haas**: Relation between the world's radius of curvature and the radius of the electron.—**Franz Rücker**: Reflection and transparency of animal tissues in the ultra-red. Considerable proportions of infra-red rays traverse the skins of reptiles and amphibia. Thus, with many lizards, 3-4 per cent of the radiation passes through the whole covering of the body, including the black peritoneum, into the body. The influence of the chromatophores is seen particularly well with the tree-frog; almost twice as much of the radiation is transmitted by the skin of the back when the chromatophores are partially contracted as when they are expanded. The chitin of insects is also transparent to some extent. The skins of xerophile, thick-skinned snakes, are usually far less penetrable by the rays than those of the shade- and moisture-loving forms.—**Julius Pia**: The Girvanellæ of the English carboniferous limestone. Three species of *Girvanella* from this source have been named, but the author considers that only two have been clearly distinguished; namely, *G. ducii* Wethered and *G. staminea* Garwood (? *G. incrustans*).—**Johann Koppmair**: General solution of the fundamental problem of photogrammetry.—**Alois Zinke**: Perylene and its derivatives (36).—**N. A. Puschin** and **M. Deželić**: Equilibrium in systems with erythritol as a component.—**N. A. Puschin** and **J. J. Rikovsky**: Compounds of carbamide and urethane with acids and phenols.

Official Publications Received

BRITISH

Ceylon Journal of Science. Section D: Medical Science. Vol. 2, Part 5, May 20th. Edited by Dr. L. Nicholls. Pp. 203-341+plates 42-49. (Colombo: Bacteriological Institute; London: Dulau and Co., Ltd.) 3 rupees.

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the Year 1931. Pp. 9. (Cape of Good Hope.)

Proceedings of the Royal Society of Edinburgh, Session 1931-1932. Vol. 52, Part 3, No. 16: Pressure Effects in the Secondary Spectrum of Hydrogen. By W. G. Guthrie. Pp. 315-322. 9*d*. Vol. 52, Part 3, No. 17: The Adrenal Gland of *Xenopus lævis*. By H. Zwarenstein and I. Schrire. Pp. 323-326. 6*d*. Vol. 52, Part 3, No. 18: The Geodesics in Einstein's Unified Field Theory. By A. Blackwell. Pp. 327-330. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Proceedings of the Royal Irish Academy. Vol. 41, Section A, Nos. 1, 2: On the Motion near Two straight Parallel Vortices, by W. B. Morton; The Radiation of Angular Momentum, by Prof. A. W. Conway. Pp. 17. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Department of Scientific and Industrial Research: Food Investigation. Leaflet No. 1: The Cold-Storage of English Plums. By Dr. Franklin Kidd and Dr. Cyril West. Pp. 5. Leaflet No. 2: The Preservation of Fruit and Vegetables by Freezing. By Dr. J. Barker and T. Morris. Pp. 9. (London: Department of Scientific and Industrial Research.)

Leeds University: Department of Pathology and Bacteriology. Annual Report, by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research, by Prof. R. D. Passey. Pp. 16. (Leeds.)

The National Central Library. 16th Annual Report of the Executive Committee, 1931-32. Pp. 55. (London.)

Thirteenth Annual Report of the Ministry of Health, 1931-1932. (Cmd. 4113.) Pp. xii+320. (London: H.M. Stationery Office.) 5*s*. net.

Board of Education. Educational Pamphlets, No. 89: Memorandum on the Teaching of Science in Senior Schools. Pp. 67. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

Census of Thunderstorms in the British Islands, 1925-1936. Summer Thunderstorms: First Annual Report, 1931. Pp. 24. (Huddersfield: Thunderstorms Census Organisation.) 2*s*. 6*d*.

The Journal of the Institution of Electrical Engineers. Edited by Rowell. Vol. 71, No. 427, July. Pp. 145-284+xx. (London: N. Spon, Ltd.) 10*s*. 6*d*.

of Public Instruction, Technical Education Branch: New nological Museum: Curator's Annual Report for Year 31. Pp. 6. (Sydney: Alfred James Kent.)

aries in Royal Parks (England). Report for Stationery Office.) 6*d*. net.

Philosophical Transactions of the Royal Society of London. Series B, Vol. 221, B476: Experiments on the Development of Chick and Duck Embryos, cultivated *in vitro*. By C. H. Waddington. Pp. 179-230+plates 22-28. (London: Harrison and Sons, Ltd.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1447 (T. 3152): Thrust Integrating Tubes—Wind Tunnel Experiments. By C. N. H. Lock, F. C. Johansen and H. L. Nixon. Pp. 22+10 plates. 1*s*. 3*d*. net. No. 1457 (T. 3204, 3211): Two Reports on Tail Buffeting. By the Aerodynamics Staff of the National Physical Laboratory. Pp. 30+26 plates. 2*s*. 3*d*. net. (London: H.M. Stationery Office.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 61: Studies in the Supplementary Feeding of Merino Sheep for Wool Production. 1: The Effect of a Supplementary Ration of Blood Meal on the Growth Rate and Wool Production of Merino Sheep on Central Queensland Pastures. By Hedley R. Marston. Pp. 31. Bulletin No. 62: A Soil Survey of the Cadell Irrigation Area and New Era, South Australia. By T. J. Marshall and N. J. King. Pp. 24. (Melbourne: H. J. Green.)

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1931. Pp. 204. (Bristol.)

Proceedings of the Malacological Society of London. Edited by R. Winckworth. Vol. 20, Part 2, July. Pp. 77-140+plates 9-11. (London: Dulau and Co., Ltd.) 10*s*. net.

Reports on Comparative Tests on "Armourplate" and ordinary Plate Glass by the National Physical Laboratory and the Department of Scientific and Industrial Research (Building Research). Pp. 48. (St. Helens: Pilkington Bros., Ltd.)

Economic Advisory Council: Committee on Locust Control. Fourth Report: Survey of Locust Investigations in 1931 and Programme of Work for 1932-33. (Cmd. 4124.) Pp. 43. (London: H.M. Stationery Office.) 1*s*. net.

FOREIGN

The University of Colorado Studies. Vol. 19, No. 3. Pp. 163-355. (Boulder, Colo.) 1 dollar.

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 175: First and Second Order Triangulation in Oregon (1927 Datum). By Clarence H. Swick. Pp. iii+89. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the American Philosophical Society. Vol. 71, No. 3. Pp. 78-133. (Philadelphia.)

University of California Publications in American Archæology and Ethnology. Vol. 31, No. 3: Ethnography of the Surprise Valley Paiute. By Isabel T. Kelly. Pp. iv+67-210+plates 17-32. (Berkeley, Calif.: University of California Press.) 2 dollars.

U.S. Department of the Interior: Office of Education. Bulletin, 1932, No. 3: Studies of Teachers and Principals employed in the Rural Schools of the United States. By Walter H. Gaumnitz. Pp. iv+122. Bulletin, 1931, No. 20: Biennial Survey of Education in the United States, 1928-1930. Chapter 22: Recent Progress and Condition of Museums. By Laurence Vail Coleman. Pp. 34. (Washington, D.C.: Government Printing Office.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 8, No. 5, May, Research Papers Nos. 434-445. Pp. 549-668. (Washington D.C.: Government Printing Office.)

Verhandlungen und wissenschaftliche Abhandlungen des 24 Deutschen Geographietages zu Danzig 26 bis 28 Mai 1931. Pp. 272. (Breslau: Ferdinand Hirt.) 12 gold marks.

Memoirs of the College of Science, Kyoto Imperial University, Series B. Vol. 7, No. 1. Pp. 53+3 plates. Vol. 7, No. 2. Pp. 55-101+plate 4. Vol. 7, No. 3. Pp. 103-158+plates 5-14. Vol. 7, No. 4. Pp. 159-203+plates 15-17. Vol. 7, No. 5. Pp. 205-250+plates 18-19. (Tokyo and Kyoto: Maruzen Co., Ltd.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 4, No. 6, Juin. Pp. 230-284. (Prague: Regia Societas Scientiarum Bohemica.)

Journal of the Faculty of Science, Hokkaido Imperial University. Series 1: Mathematics. Vol. 1, No. 3. Pp. 157-209+143-157. (Sapporo.)

Report on Clove Cultivation in the Zanzibar Protectorate, 1931. By Prof. R. S. Troup. Pp. iii+46. (Zanzibar: Government Printer.)

Sudan Government: Wellcome Tropical Research Laboratories, Khartoum. Report of the Government Chemist for the Year 1931. (Chemical Section, Publication No. 65.) Pp. 28. (Khartoum.)

The Museum Journal. Vol. 23, No. 2: Primitive Peoples of Matto Grosso, Brazil. By V. M. Petrullo. Pp. 81-184. (Philadelphia: University Museum.)

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United States National Museum. Bulletin 161: The Foraminifera of the Tropical Pacific Collections of the *Albatross*, 1899-1900. Part 1: Astrorhizidae to Trochamminidae. By Joseph Augustine Cushman. Pp. vi+88+17 plates. (Washington, D.C.: Government Printing Office.)

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1931. Pp. 20. (Entebbe: Government Printer.) 2*s*.

Field Museum of Natural History. Zoological Series, Vol. 18, No. 9: Reptiles and Amphibians from the Solomon Islands. (Reports on Results of the Crane Pacific Expedition.) By Karl P. Schmidt. (Publication 311.) Pp. 175-190. (Chicago.) 35 cents.

CATALOGUES

Astronomical Instruments. (Astro. 103E.) Pp. 16. (Berlin-Friedenau: Askania-Werke A.-G.; London: O. G. Karlowa.)

Cambridge Draught and Pressure Gauges (Indicating and Recording). (List No. 152A.) Pp. 8. (London: Cambridge Instrument Co., Ltd.)

John G. Stein and Co., Limited, Silica and Firebrick Manufacturers. Pp. 186. (Bonnybridge.)

SATURDAY, AUGUST 20, 1932

CONTENTS

Differential Fertility and Family Allowances *

THE Registrar-General is a maker of castes: he divides his people into classes according to the social status of the occupations which they follow, but his classes are to be distinguished also by differences in wealth, in culture, and in reproductivity. It is this differential reproductive rate that alarms the eugenist.

The number of children per married couple represents the contribution of a social or occupational class to the next generation, and this contribution differs very markedly from class to class as one passes in review from the teachers on towards the occupational class of the general labourer. It matters not whether one uses the yard-stick of social status, of wealth, or of culture, one finds that, on the average, the most socially eminent, the wealthiest, and the most cultured classes exhibit a much lower reproductive rate than do the socially submerged, the poor, and the uneducated.

The relative reproductivity of the different classes will be determined by differences amongst them in the birth-rate, which is a true reflection of the operation of all those agencies which raise or reduce fecundity, which condition the frequency of mating, which render fertilisation more or less certain, and which influence the viability of the embryo and fœtus. In this connexion, therefore, the birth-rate, the abortion-rate, the infantile mortality-rate, the marriage-rate, and the age at marriage all have to be considered. But since it has been shown that differences in the amount of marriage and in infantile mortality (so far as contributions to the next generation are concerned) are not so important as are differences in the birth-rate itself, and further, that differences in the number of children born to married women irrespective of age are of more importance than are differences in age at marriage, it is possible to disregard all else but differences in the actual birth-rate, and to seek reasons other than the marriage-rate and the age at marriage in order to explain the fact that, on the average, the wealthy, the cultured, and the socially eminent make distinctly smaller contributions to the next generation than do their opposites.

A social class can continue only through reproduction or else through reinforcement from without. So long as the State continues to regard the middle-class as a desirable constituent of its population, so long must parentage on the part of its membery

* The Social Selection of Human Fertility: the Herbert Spencer Lecture delivered at Oxford, 8 June 1932. By Dr. ... 32. (Oxford: Clarendon Press; London: Oxf... 1932.) 2s. net.

regarded as a social service. It appears, however, that the supply of children by this middle-class (which constitutes some 10-15 per cent of the total population) is sufficient only to replace one-half of the present parental generation. It is the case that the class is being reinforced continually by such as ascend to it from the less affluent social strata, but it has not yet been shown that the calibre of these reinforcements equals that of those whose company they join. It can be argued that the middle-class is the product of a very intensive selective process, that it created itself during the eighteenth and nineteenth centuries, its families usually having had their origin in individuals who wrenched themselves free from some harsh environment and gained social promotion in their own time through the exhibition of their own talents. It would seem that such as could exhibit abundant enterprise, thrift, and foresight were able, in those days, to attain a certain level of affluence, and that these were the founders of the middle-class.

This class is only worth saving if the qualities which distinguish it are socially desirable and are in any degree the peculiar true-breeding properties of the class. It is by no means improbable that this class has, through selection, come to be somewhat differentiated in certain respects from the general body of the population from which it sprang and from which it is recruited. Possibly it is not without significance that the children of this class are to be distinguished from those of others by differences in the intelligence quotient. Furthermore, though one should be accused of bias, it is possible to hold the view that in respect of perseverance, of ambition, of æsthetic taste, of grasp of moral principle—the very qualities that make for good citizenship—this class and its members are exceptionally well endowed.

If this be so, then it would seem that through a low reproductive rate the spread of these qualities is becoming more and more restricted with each successive generation. In this there is furnished a major problem awaiting the attention of the serious statesman. The problem would seem to be that of dissociating a low reproductive rate on one hand and the estimable qualities that make for good citizenship on the other. At the present time, and in the existing social system, it is an obvious fact, recognised by all, that it is a distinct advantage to the individual so to choose his parents that he is ither an only child or else one of two; for in these stances he can expect to be better tended, ated, and secure a better financial e chosen competitive professional career, and thus more quickly obtain that social promotion which is so universally desired than can one of a family of five to ten. To choose parents of low fertility is to choose not only one's parents but also one's environment—plentiful food, ample shelter, rest, and attractive recreation.

Infertility has an economic value, and social promotion is favoured by a low reproductive rate. In all ranks of society, infertility, whether pathological in its causes or the result of deliberate voluntary choice, endows its possessor with definite social advantages. The question to be asked and answered is this: *Is relative infertility a cause of social success, or is it a consequence? Must one be sterile to be socially successful, or does success bring sterility in its train?* Dr. R. A. Fisher, in the Herbert Spencer Lecture recently delivered at Oxford, deals with this question. The subject of his lecture was "The Social Selection of Human Fertility", and it is an attempt to create a substructure for eugenic optimism out of the genetics of populations. He presupposes that the qualities which have made for success within the social organisation that has existed during the last two hundred years in Great Britain are genetic, and is of the opinion that social promotion is gained through the expression of characters which make for useful citizenship. He makes out a very strong case for the adoption by the State of a system of family allowances. It is shown that such a system provides no economic motive either for having children or for refraining from having them, but that it merely abolishes the economic bonus for childlessness and permits parents to regulate their reproductive rates.

It is not generally recognised that a family endowment system already exists in Great Britain, but that the allowances are paid only to children of the unemployed and to those who are in receipt of poor relief. It is the case that a man with a sufficiently large family in certain of the occupational groups is actually better off when unemployed than when in employment. It is indeed provocative of thought to note that if two couples are compared, one of them childless and the other with four children, but both receiving the same income for equivalent social services, their effective incomes available for personal expenditure and savings stand in the ratio of 3 : 2, the childless couple receiving a bonus amounting to one-third of their income in consequence of not having four children.

Dr. Fisher improves upon the cry of 'equal pay for equal work', for he advocates an equal standard of living for equal work. He claims that a wage including family allowances sufficient to meet the

entire cost of children would secure this end and would cut out the heavy bonus for childlessness which is an outstanding feature of the present system. In this lecture the details of accountancy which the institution of such a system would demand are not discussed, but Dr. Fisher advocates that in general the allowance payable to parents in each social grade should be proportional to the basic salary in that grade—that is to say, that the allowance should be equivalent to the actual cost in expenditure and savings incurred on the average on behalf of each child in the group.

Brief reference is made to the system of family allowances which was instituted after the War by a group of French industrialists and which is now extended to include all the wage-earning classes throughout the country. In Great Britain, the beginnings of such a scheme are seen in the establishment by Sir William Beveridge of a system of family allowances for the teaching staff of the London School of Economics. In the University of Edinburgh, parentage is made less of a burden by the fact that the children of the staff are excused class fees.

Dr. Fisher possesses all the qualifications of the really good propagandist. If he wears a professional label, it is that of the statistician; if he has a hobby, it is biology. He is a propagandist in human biology and rides his hobby in a most attractive fashion. His blandness is really dangerous; nothing is easier than to accept his views without question. However, his persuasiveness is not greater than his knowledge. If there be an alternative to this simple, lucid, concise suggestion, then it must undoubtedly come from a skilled economist who is also a confirmed bachelor.

If, as Dr. Fisher implicitly states, a system of family allowances encourages a rise in the reproductive rate, then much of the infertility of the middle-class can be nothing more than unexploited fertility—that is to say, middle-class parents could readily have more children if they should so choose. This controlled fertility may result from the habitual use of contraceptives, or, as seems more probable, it may be due to the fact that in this class the frequency of sexual intercourse is relatively low. It appears that a child that is not a burden is quickly conceived. If this is the case, if, in the opinion of the State, a higher reproductive rate on the part of the middle-class is to be desired, then it may well be that if and when prosperity returns the deduction from the salaries of civil servants and others which were recently made will not be restored, but instead a system of family allowances will be instituted.

It has to be recognised that the efforts of the many who wish to correct what they regard as the evils of the differential birth-rate by endeavouring, through an appeal to idealism, to induce others of their own group to beget larger families have not met, and will not meet, with any discernible success. It is quite useless offering the alternatives of the present comfort of the reproducers on one hand and the indefinitely future welfare of society in general on the other. This latter appeal possesses no strength.

It was true, and possibly is still true, that a man may be so moved by his idealism as to be willing to die for his country, but it is not to be expected that he will be equally willing to procreate in her service until he has been convinced that his children will enjoy the advantages that have meant so much to him. Economic security means more to the average man of the middle-class than does the decline of the Empire or the suicide of the race.

A Synthesis of Medieval Science

Introduction to the History of Science. By George Sarton. Vol. 2: *From Rabbi ben Ezra to Roger Bacon.* (Carnegie Institution of Washington, Publication 376.) Part 1. Pp. xxxvi + 480. Part 2. Pp. xvi + 481-1251. (Baltimore, Md.: The Williams and Wilkins Co., 1931.) 12 dollars.

THE first volume of Dr. Sarton's "Introduction to the History of Science", already reviewed in NATURE, was universally and deservedly acclaimed as a major contribution to our knowledge of the growth of civilisation. The second volume, which follows after a brief interval of four years, covers the twelfth and thirteenth centuries—or, as Dr. Sarton puts it, the period from Rabbi ben Ezra, "one of the greatest Biblical commentators of the Middle Ages", to Roger Bacon, the *Doctor Mirabilis*. There is probably no single scholar competent to subject the book to a thorough and authoritative critical analysis, but the general verdict can scarcely be other than that the author has fully maintained, and, indeed, in several notable respects, surpassed, the high and exacting standard he set himself in the first part of the work. One finds it difficult to decide whether Dr. Sarton is more to be praised for his courage in attempting so stupendous a task, or for his unflagging determination in carrying it to so successful a conclusion; it is at least certain that no future historian of science, of learning as a whole, or of civilisation itself, will consider his library a-quately equipped unless a copy of Sarton' arm's reach.

It would be an egregious mistake to regard the "Introduction" as nothing more than an elaborate, comprehensive, and conveniently arranged bibliography. Dr. Sarton's ambition—achieved with a degree of completeness that must afford him the keenest satisfaction—was to provide a framework for the study of medieval science and medieval thought, and to express as exactly as possible the state of our present knowledge on each topic. While full bibliographical references are clearly essential to such a framework, in themselves they are but the unit bricks that have to be classified, arranged, and mortared together in orderly fashion before the significance of each and of all can be appreciated. It is in this synthesis of scholarship that Dr. Sarton excels. Enthusiastic for the widest vision (but no less for accuracy in detail), he is free from that intensive predilection for any particular period or problem which, necessary and laudable in other circumstances, would seriously disturb the balance of such a scheme of integration as is undertaken in this book. As a consequence of his catholicity of interest, he has been able to maintain, between the divers and manifold aspects of the medieval corpus of knowledge, an equilibrium that even the most narrow specialist must recognise to be just.

Yet we fancy that many specialists will be astonished at the intimate acquaintance that Dr. Sarton shows with the recondite details of their particular fields. Such a trivial question, for example, as the suggested identification of the Latin writer Artephius with the poet and vizier Al-Tughra'i does not escape him, while a host of similar instances might be adduced to prove that his conscientiousness has extended into every section and every subject. His picture of medieval learning, indeed, is not the work of a poster artist, or even of an impressionist; it shows rather the Pre-Raphaelite characteristic of minute accuracy in detail, and if the minutiæ do not unduly obtrude themselves, it is because the broad features of the canvas are too truly designed and too skilfully limned. This dual excellence is rarely found in such perfection as in Dr. Sarton's book, where the reader desirous of a bird's-eye view of wide stretches of territory will find equal satisfaction with the scholar who seeks specific information upon some individual point.

Of the twelfth century, Dr. Sarton remarks that it was essentially a period of transition and compromise, when exchanges between the three main civilisations of Europe and the Mediterranean world —the Jewish, the Christian, and the Muslim—were [illegible] than they had ever been before. The [illegible]on from Arabic into Latin was fervently undertaken by scores of accomplished and indefatigable men—Gerard of Cremona alone translated nearly a hundred treatises, some of them of immense size—and the foundations of a new, composite, Greco-Arabic-Latin culture were laid down. In mathematics, the use of Hindu numerals was introduced, and Muslim algebra was transmitted to the West by the efforts of such men as Adelard of Bath, John of Seville, and Robert of Chester. The first Latin translation of Euclid—also from the Arabic—was made about 1142, while in 1149 the trigonometrical tables of Al-Battani and Al-Zarqali were adapted, for astronomical purposes, to the coordinates of London. The Almagest of Ptolemy was available in Latin by 1172; fifteen years later Jabir ibn Aflah's "Correction of the Almagest" was added—again by Gerard of Cremona—and although a flood of astrological treatises simultaneously deluged the Latin West, it was in the twelfth century that European astronomy showed its first real activity since the days of classical Greece.

Chemistry, in the guise of alchemy, was another twelfth century importation from Islam, and by the end of the century original treatises were beginning to appear. Dr. Sarton places Geber's "Sum of Perfection" towards the end of the thirteenth century, but it is more probably to be regarded as the culminating point of the previous century's alchemical acquirements. Physics, geography, and natural history shared in the general reawakening of learning, while medicine benefited by the translations of Hippocrates and Galen, among the Greek authors, and of Rhazes, Avicenna, Al-Zahrawi, and Ibn al-Wafid (Abenguefit) among the Muslims.

By the middle of the thirteenth century the intellectual centre of the world had definitely moved. Islam and Israel were still doing a large share of the work, but Christian scholarship had at length established that preponderance which was only to increase with the passage of time. In the second half of the century "the hegemony of Christendom . . . was absolutely indisputable". Baghdad was sacked by the Mongols in 1258, and though the culture of Islam was not thereby completely destroyed, it nevertheless suffered a grievous blow. The Jews were nearly everywhere reduced to minor importance, and almost ceased to have international significance in the world of learning. Finally, this "time of Roger Bacon, of Jacob ben Mahir ibn Tibbon, and of Qutb al-Din al-Shirazi" marked the triumph of Aristotelianism in the form of Thomist philosophy.

It is not surprising that Dr. Sarton has selected Bacon as one of his eponymous heroes for chrono-

logical characterisation. "Bacon", he says, "was essentially an encyclopædist; that is, he was tormented with the idea of the unity of knowledge, and his life was a long effort better to grasp and to explain that unity." Shall we substitute 'Sarton' for 'Bacon'? Then the truth of the statement is in no wise diminished. E. J. Holmyard.

Australian and New Zealand Ornithology

(1) *What Bird is That? a Guide to the Birds of Australia.* By Neville W. Cayley. Second edition. Pp. xx + 319 + 44 plates. (Sydney: Angus and Robertson, Ltd.; London: The Australian Book Co., 1931.) 12*s.* 6*d.*

(2) *New Zealand Birds.* By W. R. B. Oliver. Pp. viii + 541 + 6 plates. (Wellington, N.Z.: Fine Arts (N.Z.), Ltd., 1930.) 30*s.*

(1) Australian ornithological workers have been very active during this century. Campbell opened in 1901 with his book on the "Nest and Eggs"; this was followed (1901–14) by a much larger work by North on the same subject, which also included the descriptions of the birds. In 1906, Hall issued a second edition of his "Key" of 1899; this edition was illustrated by photographs of the birds, taken from Gould's folio work. This led up to the famous "Australian Bird Book" by J. A. Leach, which ran into seven editions. Leach gave a small reproduction in black and white of all the birds, and a few coloured plates depicting in miniature many forms, of which nine went to a full plate.

In this present volume, Mr. Cayley, an artist, has drawn coloured figures of all the birds of Australia and these have been reproduced in the best style, thus enabling a student to identify any bird seen on a ramble by the water or inland. This book can be called the 'big brother' of the "Australian Bird Book", but the colour process of reproducing the plates has much improved since the latter was published and Cayley's plates are admirable.

We learn from Cayley's book that it was sponsored by the Gould League of Bird Lovers to celebrate the coming of age of that useful society. The purpose of this volume is to assist and encourage those Nature lovers who desire to gain a more intimate knowledge of the birds of Australia.

The work is divided into four main sections: forest-frequenting birds; birds of the heath-lands and open country; birds of the lakes, streams, and swamps; and birds of the ocean and shore. These are again divided into small groups, such as birds of the brushes and big scrubs, birds of the open forest, etc.

Finding ourselves in any type of country and seeing a bird unknown to us, we turn up our book to the chapter dealing with the kind of territory we occupy: there we find a coloured plate depicting the birds of that region. Having identified our picture and noting its number, we turn to that number in the letterpress, where we find the name of the bird, its distribution, notes on its habits and a description of its nest and eggs, and the months of the year when the eggs are to be found. Thus we are able to answer the oft-repeated question: What bird is that?

On p. 32 we find the only subspecies admitted, and that a new one, a form of masked owl, called *Tyto novæhollandiæ troughtoni*, a cave-dweller in that part of Australia where trees are absent, called Nullarbor Plain, to emphasise the fact. We doubt the wisdom of describing a new bird in this kind of book, especially as there are so many journals devoted to ornithology, which the compiler of the *Zoological Record* must examine. On p. 197 we find the genus *Emblema* superseded by *Cayleyna* with no explanation, and as this is the first time we have come across this word, we wonder why. We know *Emblemus* of Dejean, 1821, but here it is a nude name; perhaps it was quickened before 1842.

The author claims his volume to be "a Guide to the Birds of Australia". This it certainly is, and if we can answer the question on the title-page he can be satisfied that he has fulfilled his mission. The nomenclature followed is modern, as is the English name of each bird. The printing and paper are good, and the coloured plates leave little or no room for improvement. In the appendix, eleven introduced birds are treated, and the index of twenty-three pages seems complete.

This volume is a good example of the 'evolution' of a bird book. It will be rather difficult for a successor to think of the next 'stage' in development of a popular work. The size of the volume renders it easy to carry with us on our journeys.

(2) New Zealand! What visions of far-away places the name brings before us, and of tattoo-faced Maoris, savage and cannibalistic, at times; a fierce warrior race, but always an honourable foe. New-comers, comparatively speaking, to this paradise in the Pacific, from the 'Islands of Unknown', they landed in five differ- and settled in both North and S

and, 'tis said, devoured the original inhabitants. They also exterminated the large struthious birds known as 'moas'.

Our vision goes back to Tasman the Dutchman, who after discovering Tasmania, in the middle of the seventeenth century, sailed on east, and on Dec. 13, 1642, discovered New Zealand and named it after a small, flat province in Holland. This explorer never landed, for when he sent a boat off to obtain fresh water the Maoris killed some of his men, so he sailed north, to discover the Friendly Islands. About this time we have reason to believe that the moas had not long become extinct —indeed, some may have lingered on into the seventeenth century.

Now we come to the voyage of Capt. Cook, who was the first white man to land on the island; he, too, at first met with hostility from the Maoris, in Poverty Bay, in October 1769. On his second voyage, however, Cook had with him the Forsters (father and son) and Dr. Sparrman. These men collected birds at Dusky Sound, and that was the beginning of New Zealand ornithology. The sea birds collected on the first voyage are common to both Australia and New Zealand. Then we have the French landing from the *Coquille*, the *Astrolabe*, and this latter ship again with the *Zelee*; Gray, who did the birds in Dieffenbach's "New Zealand", 1844, as well as in the account of the *Erebus* and *Terror*, the bird parts of which were published in 1844–45; then Peale, whose work was published in 1848; thus leading up to Buller's "Birds of New Zealand", 1872–73, the second edition in 1888 and the supplement in 1905–6. In this work are the observations of Potts, who probably did more than any other observer in New Zealand to complete the life histories of the birds. In the New Zealand avifauna is included that of the Kermadec Islands and the Chatham and Antipodes Islands. This brings us to the book under review, Oliver's useful volume, a complete and up-to-date work, of which every ornithologist should possess a copy.

In the beginning we have a history of ornithology in the islands; chapters on the ecology, migration, changes in the fauna; the economic value of birds, and on the classification. This is followed by a history of the moas, leading to all the known forms, copiously illustrated with photographs of the heads and sterna.

Then we come to the living birds, all of which are carefully worked up in the modern method. ... orders, families, and genera are discussed, ... the species, of which a full history is ... bird described, its affinities and ... mutants, if any, given; the nestling and egg are described where known, and the breeding season indicated. Then follow the distribution, habits, food, voice, and breeding habits, and its relation to man.

The list of birds thus treated, of purely New Zealand forms, is 230, excluding the moas and introduced birds. All through the work, the extinct birds are given their place, as well as those birds introduced from Australia, etc. A complete index is added.

At the end of the book, about fifteen European, one Indian, and two Australian birds are also treated in the same way as those in the body of the work. Most people will regret the introduced birds, as in so many cases they depose the native-born and may eventually become harmful.

The new forms described are *Pachyptila turtur fallai*, *Cyanoramphus novæzelandiæ chathamensis*, *Bowdleria punctata stewartiana*, *Prosthernadera novæseelandiæ chathamensis*. This last form was described by Dr. E. Hartert two years before, under the same name. Amongst the extinct forms we find a new family, Anomalopterygidæ; a new genus, *Pachydytes*, and two species of extinct penguins, *P. ponderosus* and *P. novæzealandiæ*; and new genus and species, *Euryanus finschi*, for the extinct New Zealand teal. To the list of the birds of New Zealand must now be added *Sterna macrura*, the arctic tern; *Pisobia melanotos*, the pectoral sandpiper; *Crocethia alba*, the sanderling; *Lobipes lobatus*, the northern phalarope; *Microtribonyx ventralis*, the black-tailed water-hen; *Threskiornis molucca*, the white ibis (Australian); and *Graucalus novæhollandiæ*, the black-faced cuckoo shrike.

G. M. MATHEWS.

Italian Fisheries

Ministero dell' Agricoltura e delle Foreste: Direzione-Generale dell' Agricoltura. La pesca nei mari e nelle acque interne d' Italia: notiziario tecnico e legislativo e repertorio della industria e del commercio dei prodotti pescherecci. Vol. 1. Pp. xvi + 356. Vol. 2. Pp. x + 710. Vol. 3. Pp. ix + 412. (Roma: Istituto Poligrafico dello Stato, 1931.) 3 vols., 100 lire.

FASCIST Italy has been quick to recognise that in its fisheries, no less than in any other branch of the nation's commerce, future progress depends upon the efficiency with which the industry is conducted. As an initial step towards rationalisation, therefore, an exhaustive survey of the fisheries situation in all its phases has been under-

taken, in which no relevant subject appears to have been overlooked. Testimony to the thoroughness of this official 'stock-taking' is provided by these three remarkable volumes recently issued by the Italian Ministry of Agriculture and Forestry, the government department responsible for the administration of the fisheries. It is impossible here to give more than a bare indication of the contents of the three volumes, which comprise nearly 1500 pages of text, accompanied by a wealth of photographs, diagrams, charts, and plates, both coloured and uncoloured.

Vol. 1 commences with a descriptive catalogue of the various institutions and corporate associations which are directly interested in fisheries matters, whether these be scientific institutions such as marine laboratories and fish-hatcheries, schools, museums, and learned societies, or industrial syndicates, either national or local. Not the least instructive part of this section is the grouping of the different institutions and associations in relation to the particular department of the government to which they appear to be responsible. The second part of vol. 1 is devoted to the laws governing national fishing, and to the international conventions honoured by the State.

Vol. 2 is a detailed treatise on fishing technique. Beginning with the sea fisheries, descriptions and illustrations (many coloured) of the exploited fishes, crustaceans, and molluscs are first given, and then follows a most interesting and detailed account of fishing methods and results. In this volume, the charm which old-time methods of fishing excite is unusually evident because of the rich variety in boats and gear used in the Italian sail fishery. Nevertheless, this does not detract from the interest aroused by the description of the more modern if more prosaic steam fishery. Leaving the sea and turning to the fresh water, the subject matter is very complete.

The third volume is concerned with the marketing of fishery products, either as fresh commodities or after some form of conservation. Of the three volumes, this one is the most domestic, in that it deals with matters which are more the concern of the home government and the fishing industry than of the lay reader outside Italy. Yet it demonstrates in a very simple way the thoroughness with which the survey has been conducted. Thus, more than seventy pages are devoted to an enumeration of the common names used at different places for the economically valuable fishes, in order, it is assumed, to leave no room for doubt on account of local differences. In many instances, indeed, the common name, dialect name, and scientific name are given for one and the same locality. Or again, whereas it would not have been an unusual procedure if the volume gave estimates of the number of fish merchants, salesmen, boatbuilders, and personnel of other ancillary occupations, it is noteworthy that *individual* merchants and salesmen, etc., are named and classified according to the locality in which they are operating.

Altogether, this 'blue-book' on the Italian fisheries—for such is the most appropriate description of it—is a publication of a character almost unique, in that it is a State guide to the fisheries, prepared by a government, lavishly illustrated, and printed in the State Printing House. The work which it most closely resembles is the great "Handbuch der Seefischerei Nordeuropas" published in Germany, to which, it must be confessed, nationals of Great Britain must refer for the most complete description of British fishing. Certainly there is no comprehensive account of our fisheries written in English which can claim to be equivalent to either the Italian or German works. E. Ford.

The Internal Combustion Engine

The Internal Combustion Engine. By D. R. Pye. (Oxford Engineering Science Series.) Pp. xii + 250. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 15*s*. net.

Under this heading, two books on internal combustion engines, one by Prof. W. E. Dalby and the other by Mr. H. R. Ricardo, were recently reviewed in these columns (Nature, Nov. 28, 1931, p. 886). Mr. Pye's book differs considerably from either of these in scope and outlook. It is a very complete monograph on the theory of the engine. It is written in the clear and attractive style which those who are familiar with Mr. Pye's previous writings have learned to expect from him. The author deals fully with the practical nature and the comparative efficiency of combustion at 'constant volume' and 'constant pressure'; the nature of fuels; detonation; combustion in the cylinder; and the effect of various factors on thermal efficiency. There is a final useful chapter on the testing of engines. There is no unnecessary matter in the book, which undoubtedly presents the fullest and at the same time most concise description of the theory of the engine so far as it has been developed by modern research. Mr. Pye naturally draws most of his illustrations of the theory from the results of his own experience with high engines; he does not touch on the

problems of slow-running engines, but the underlying theory is common to all types.

There is little in the book to which a critic could take exception. Perhaps too much value is attached to the measurement of the air consumption of engines. When the fuel is largely or mainly composed of hydrocarbons, whether gaseous or liquid, there is a point at which the consumption of air per horse power developed is a minimum. This point occurs when the mixture is rich, that is, when there is too much fuel for complete combustion. Over a wide range of mixtures the air consumption per horse power remains practically constant, so it is comparatively easy to measure accurately in practice. The minimum air consumption gives a measure of the overall efficiency of the engine, but it does not give a measure of the minimum fuel consumption of the engine, or of the amount of fuel that may be lost by imperfect distribution in a multi-cylinder engine. Mr. Pye, following Mr. Ricardo, assumes that it does, and arrives (on p. 135) at certain conclusions which appear to the reviewer to be wrong, although perhaps not far wrong. But it is accidental that they are not far wrong. Again (p. 154), in the course of a general discussion on thermal efficiency referred to fuel or air, it is not strictly true to say that in gas engines operating on carbon monoxide or hydrogen, the heat output and the efficiency is the same for a mixture containing 80 per cent of the gas required for complete combustion as for a mixture containing 80 per cent of the air required.

These, however, are minor blemishes in a first-class work, which has been needed for some time; it can be strongly recommended to all serious students of the subject, and particularly to those who are engaged in unravelling some of the many properties of the internal combustion engine that are still imperfectly understood. It is unfortunate that the price of the book will prevent its purchase by many who would gain by having it on their shelves, but this is a general criticism applying to most scientific books.

Colloidal Properties of Smokes

Smoke: a Study of Aerial Disperse Systems. By Prof. R. Whytlaw-Gray and H. S. Patterson. Pp. viii + 192 + 12 plates. (London: Edward Arnold and Co., 1932.) 14*s*. net.

IN this book the authors give a connected account of the large body of work on disperse systems which they have for some years been carrying together with the relevant researches of other investigators. The subject is one of considerable theoretical and practical interest. On the theoretical side, the contrast in properties between a substance dispersed in a liquid medium and one dispersed in a gas throws light on the mechanism of general processes in sols, such as that of coagulation; on the practical side, the coagulation of smokes assumes particular importance in the industrial precipitation of fumes and in the consideration of urban fogs; while as an example of the bearing of the subject on the world of atomic physics, we may quote the experiments of Ehrenhaft on the sub-electron, the fallacious conclusions of which our authors trace to a neglect of the processes of coagulation common to all smokes.

The technique of all observations on smokes—counts of particles, size of particles, density of particles, to quote some of the most important—is a difficult one, and, very wisely, much of the space is devoted to a discussion of the experimental methods by which the authors have been enabled to obtain reproducible smokes and consistent measurements. The particular ultra-microscopic method by which certain earlier errors of counting have been eliminated is described in detail, as well as other methods by which it has been checked. Very ingenious is the way in which the velocity of fall under gravity, combined with the velocity of rise of the charged particle in a known electric field, has been used to determine the density of the particles; it is, of course, reminiscent of Millikan's method of determining e, but in this case e is taken as known, within an integral multiple, which is in its turn determined by carrying out four or five experiments, and selecting integers which give a consistent result. Some of the results of this method are very striking. It is, perhaps, only to be expected that the density of the solid particles should be very much below the bulk density of the substance in question, but, turning to liquids, whereas with oil droplets the density comes out in good agreement with the bulk density of oil, for mercury droplets the observed particle density is about 1·7. The reason for this the authors do not discuss.

While it is shown that Smoluchowski's theory of coagulation in liquid media can be adapted to give a good account of the very careful measurements of coagulation of smokes carried out by the authors, many of the problems described in this book are still in the early stages of investigation rather than in the stage of final solution. The movement of the particles under the influence of light, known as photophoresis, is still, when it comes to the point, quite obscure: the electrification of smokes, as

the authors point out, needs much further work before the distribution of charge with particles of different substances, and different methods of production, can be tolerably understood. A very sound beginning has, however, been made, and it is not the least merit of the book that, while what has been achieved is soberly set down, no attempt is made to gloss over the very grave difficulties still to be met in many parts of the subject.

E. N. DA C. A.

Short Reviews

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 25: *Geophysik.* Teil 2: *Physik des festen Erdkorpers und des Meeres.* Unter der Redaktion von G. Angenheister. Pp. xiv + 823. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1931.) 74 gold marks.

THIS book is good in places. Prof. Tammann discusses geochemistry. His article contains a needed warning against the too ready acceptance of the hypothesis of a sulphide shell of considerable thickness. On the other hand, he asserts that there is a critical pressure, above which the melting point decreases with pressure, and makes no mention of Bridgman's criticism of this hypothesis. G. Kirsch deals with radioactivity, age determinations, and heat supply, on the whole well, but gives on p. 51 a misleadingly incomplete statement of the nature of Jeffreys's objections to the theory of periodic melting. Kossmat's article on tectonics is useful and critical, though too short for the subject, and there is a shortage of quantitative data on the topics discussed.

The figure of the earth is treated by Schmehl; this article is notable for a correct statement of Stokes's formula, which has been misquoted in several recent German works. This section and that of K. Jung on the interpretation of gravity variation are uniformly good. E. Tams gives a good account of the distribution of earthquakes in place and time, and O. Meisser of the theory of elastic waves. Krumbach's article on seismology, however, shows some serious omissions. There is no mention of the Milne-Shaw seismograph, with which so many observatories are now equipped. In dealing with dispersion of surface waves, there is no mention of the distinction between wave-velocity and group-velocity, or of the important work of Stoneley and Tillotson. On p. 520 the author makes the surprising statement that Jeffreys agrees with S. Mohorovičić and Gutenberg that the thickness of the upper layer is 40 km., though there is a correct, but incomplete, reference to one of the papers in which Jeffreys estimated it as about 12 km.

The articles on oceanography, by Defant, and on tides, by Hopfner, are excellent summaries of existing knowledge, including recent British and American work.

The index shows lack of care. Three references to J. C. Adams should be to L. H. Adams, and "R. L. Lawson" covers the identities of A. C. Lawson and R. W. Lawson. Some reluctance to believe that a Christian name can begin with the letter I has affected the references to Newton, Bromwich, Taylor, and Lehmann; and H.M.S. *Challenger* seems to be thought to be a person. Several other authors have their names misspelt or wrong initials given.

H. J.

Vital Records in the Tropics. By P. Granville Edge. Pp. xi + 167. (London: George Routledge and Sons, Ltd., 1932.) 7s. 6d. net.

THIS little book may be recommended with confidence to the consideration of medical officers, administrators, and officials in tropical countries whose duties bring them in contact with a backward indigenous population. The case for the record of vital statistics is argued convincingly but temperately, and, as appears, with a full appreciation of the difficulties involved.

When dealing with methods of obtaining and recording statistical material, the author warns his readers that the trials of the recording officer go far beyond the suspicion, indifference, or stupidity which hamper, for example, the census among the civilised illiterate. These elements are indeed present, but to them must be added the effects of exaggerated rumour, taboos, social regulations, and an unlimited number of magical and religious concepts and prohibitions. It is made abundantly clear that the census officer and vital statistician must know something more than a smattering of anthropology and the bearing of anthropological data on his work, if his duties are not to lead him into trouble. At the same time he must be an acute judge of native character in the individual, in order that he may keep a check on the idiosyncrasies of his native assistants.

It is in view of these difficulties that the author, wisely it would seem, favours, at least in the initial stages, "small scale inquiries", that is, the intensive investigation and detailed record of single units (in native social organisation), of which the results can afterwards be combined in larger and larger unities until the frontiers are ultimately reached. The difficulties due to migratory habits of the native, whether normal or in an emergency, such as illness, are noted, and certain remedial measures suggested; but the author deals with a village population only, and does not indicate a method of approach when a population is nomadic, as, for example, the Masai.

Handbuch der Geophysik. Herausgegeben von Prof. Dr. B. Gutenberg. Band 1, Lieferung 1. Pp. vii + 308. 54 gold marks. Band 2, Lieferung 1. Pp. viii + 564. 102 gold marks. Band 3, Lieferung 1. Pp. ix + 570. 64 gold marks. Band 6, Lieferung 1. Pp. v + 312. 63 gold marks. (Berlin: Gebrüder Borntraeger, 1930–1931.)

FOUR more sections of this learned work by numerous authors are now available. It would [illegible] easy to find defects in it, but it would [illegible] difficult to do it better. What strik[illegible]

particularly is the inevitable fact that, in a comprehensive work of this character, sections are liable to become out of date owing to later work while the book is in the press; and most of the faults that one might find would be of this nature.

Prof. Nölke gives a thoughtful account of theories of the origin of the solar system, but does not appear to have grasped the essential difficulty of explaining how the comparatively small masses of the planets succeeded in holding themselves together for a long enough time to be able to condense. In places also he seems to have misunderstood the work of other investigators. Berg, writing on geochemistry, supports the eclogite-sulphide constitution of the rocky shell, but Gutenberg himself seems to agree with the reviewer that the evidence is in favour of dunite. Other chapters deal with the figure of the earth, its age, geological history, thermal history, igneous activity, movements of the crust, effects of ice, and geophysical prospecting.

Special mention may be made of Gutenberg's theory of continental spreading. He admits the force of the mechanical objections to continental drift as usually understood, but notices that the weight of continents implies shearing stresses within them of the order of magnitude of the strength, and consequently supposes that they may have spread out under their own weight. H. J.

Business and Science: being Collected Papers read to the Department of Industrial Co-operation at the Centenary Meeting of the British Association for the Advancement of Science, London, September 1931. Edited by R. J. Mackay. Published by Authority of the Council of the British Association for the Council of the Management Research Groups of Great Britain. Pp. xvi + 312. (London: The Sylvan Press (Henderson and Spalding, Ltd.), 1932.) 5*s*.

The various papers collected in this volume form a valuable contribution to the study of problems of management. Mr. B. Seebohm Rowntree points out in a foreword that good management is the most important and most dependable factor in the prosperity of a business. He emphasises that business management is a complicated science which must be studied as laboriously as one studies chemistry, medicine, or engineering, and on the extent to which individual employers succeed in mastering that science will depend not only the prosperity of their own firms but also that of the nation to which they belong.

The field covered by the papers is very wide, and includes contributions from some forty speakers, grouped into five sections, entitled "The Study of Management", "Preparation for Management", "Body and Mind at Work", "Some Higher Management Problems", and "The Development of Invention". In the section "Preparation for Management" an interesting account is given of various educational institutions which aim at providing training for the higher administrative posts [in] industry. Viscount Leverhulme describes the [Tra]ining College and the 'Trainee System' [of Leve]r Brothers; M. Pierre Jolly explains the methods adopted at the Business Preparation Centre recently inaugurated by the Paris Chamber of Commerce, of which a special feature has been the establishment of a bureau to collect and prepare materials drawn from actual business problems to be used as 'cases' for demonstrating to students the application of theoretical principles to practice; Dr. Bowie details the methods adopted in the College of Technology, Manchester, where the first Department of Industrial Administration was established in Great Britain; Prof. Florence describes the commerce course of the University of Birmingham, while Prof. McNair tells of the work carried out at the Graduate School of Business Administration, Harvard University.

Sexual Life in Ancient Greece. By Hans Licht. Translated by J. H. Freese. Edited by L. H. Dawson. Pp. xv + 557 + 32 plates. (London: George Routledge and Sons, Ltd., 1932.) 42*s*. net.

The late Dr. Licht's study of the sexual life of the Greeks of antiquity is a marvel of erudition. He ransacked Greek literature from end to end—from Homer to the latest writers in the Greek tradition of the beginning of the Middle Ages—and there is no side of eroticism to which any reference is made that he did not bring under review. The attitude of the Greeks towards the human body, their clothing, their marriages, the place of sex in festivals and games, in the theatre, and in religion are demonstrated by reference to, or quotation from, their own statements; while sexual activities in the relations between men and women, prostitution, homosexuality, and a variety of other matters pertaining to sex are described in detail on the basis of material from the same source.

Although it must be admitted that sensuality in the broader and original sense played a large part in the life of the Greeks, it may seem that Dr. Licht is inclined to attach too much importance to eroticism. He regards it as "the prime cause of old Greek culture and the centre of Hellenic life". It is easy to attach too much weight to their frank admission of certain facts. Dr. Licht is also inclined to misinterpret the reticence of classical studies on these matters. The facts were recognised, at any rate in more recent scholarship, if not treated with the minuteness and particularity of the present study.

A History of Later Greek Literature: from the Death of Alexander in 323 B.C. to the Death of Justinian in 565 A.D. By Prof. F. A. Wright. Pp. xi + 415. (London: George Routledge and Sons, Ltd., 1932.) 18*s*. net.

This most helpful compendium of the later Greek literature seems to us to throw much light on the intellectual atmosphere of the period covered. The Alexandrian school of philosophers and scientific workers, such as Euclid, Aristarchus, Archimedes, Eratosthenes, and Hipparchus, is given all the prominence it deserves. It is, however, the prose writers and poets who interest the author most; and the quotations he gives from their works add to the value of his criticisms. T. G.

Scientific Research and Industrial Development

IT is difficult if not impossible to appreciate the potentialities of science in industry or in society, or to assess accurately any plan which science can offer us, apart from the consideration of the relations between science and industry which have developed in the past and as they exist to-day. Nor is this a simple task of history. It is immensely complicated by the dynamic character of both science and industry. Society itself does not change its aspects more completely or rapidly than science or industry under the impact of science. For this reason prediction as to the results of planning industry or society on scientific lines is extremely rash. All that can be said is that the scientific method offers a reasonable chance of arriving at an unprejudiced solution of many of our problems and that its technique is sufficiently elastic to be adapted to the solution of new problems as they arise.

The most rapid review of the relations between industry and science during the last century provides convincing evidence of the power of science to assist in the development of industry and the amelioration of society. Of this there are few more striking examples to be found than in the field of fuel economy. A century ago Great Britain was passing through a depression fully comparable with that of the past two years and probably involving even more acute distress. The outlook in the coal and iron industries was gloomy in the extreme, yet at that very time the researches of Michael Faraday on electromagnetic induction were preparing the way for the immense development of the electrical engineering industries with their many branches to-day. The scientific discovery of the production of electric current by mechanical rotation in a magnetic field is the germ from which the dynamo and through it all the numerous branches of electrical power and electric light have sprung. Simultaneously, the engineer was applying his science to the development of railway transport and the advantages of gas lighting were slowly spreading over the country from London and the larger cities.

All these developments themselves induced large demands for coal and iron and finally steel, but as Prof. W. A. Bone pointed out in a recent brilliant lecture, it was the continuous application of scientific methods in the utilisation of fuel that made for progress. James B. Neilson's invention of the hot blast in iron smelting, Whitwell's development of the regenerative principle in blast furnaces, Bessemer's and Thomas and Gilchrist's discoveries in steel making, the Siemens gas-fired open hearth regenerative furnaces—these were all advances in economic production based upon the application of scientific principles to the daily problems of industry, and often upon a scientific study of fundamental laws of heat exchange economy or the complex chemical reactions occurring in the furnace, such as Lowthian Bell carried out for blast furnaces. The gas and coke industries show a continuous record of expansion which is inextricably linked with scientific method and discovery; the Bunsen burner, the Welsbach incandescent mantle, incandescent surface combustion, are all examples of independent scientific discoveries the utilisation of which has profoundly affected the development of the industry.

Similarly in power production the scientific work of Carnot, the experimental researches of Joule, the thermodynamic work of Clausius, Rankine, and Thomson led to the evolution of a scientific theory of the steam engine on which later developments were based. Sir Charles Parsons' invention and development of the steam turbine, perhaps the greatest mechanical achievement of the century, cannot be separated from scientific method and its application to industrial problems. The internal efficiency of the turbine itself has since been increased by the scientific study of nozzles, 'bleeding' and the use of higher velocity ratios, while other scientific work with higher boiler pressures, higher vacuum in the condenser, superheating, regenerative 'cascade' fuel-heating, etc., has increased the thermodynamical efficiency of the cycle. Nor have these achievements exhausted the possibilities. It is probable that the opportunities for pioneering in this field for the next generation are as great as ever; much yet remains to be done, particularly in extending scientific control in the utilisation of fuel, which incidentally lies at the root of the smoke abatement problem.

In spite, however, of the convincing demonstration in the past of the power of scientific investigation to alleviate the difficulties of the coal and fuel industries, a hiatus between knowledge and action persists which adds considerably to the difficulties in which the coal industry finds itself to-day. Not even the growing seriousness of atmospheric pollution or the intensity of the unemployment situation has driven Parliament to consider co-ordination in the utilisation of our coal resources in the form of smokeless fuel or oil fuel as a possible economic policy worthy of development. The fuel problem and the competition between raw coal, gas, and electricity is still allowed to develop along haphazard lines, without any attempt to plan and enact a scientific and economic national policy. To this position no contrast could be more startling than the discussion on fuel subjects at the jubilee meetings last year of the Society of Chemical Industry, which was planned to elucidate definite answers to such questions as the probable effect upon the amount of coal raised of the increasing use of oil, of the future development of the gas and electrical industries, of a large development of low-temperature carbonisation, or of a general improvement of the standard of living.

Only upon the considered answers to such questions can an adequate fuel policy be based, yet here again it is science and industry and not P[illegible] ment which is conducting the inquiry. [illegible] ference indeed took a sombre view of [illegible]

of any increased demand for coal, Dr. Lessing considering that a decrease in consumption is more probable; and even in the development of the hydrogenation process, prospects of an increased output of raw coal are not bright. Although international agreements might secure more lucrative prices, they are unlikely to affect the tonnage of coal raised. Lieut.-Commander Kenworthy's suggestion that scientific workers, economists, and business men should set up a representative body to examine the economic side of the coal problem was itself a confession that Parliament is not the instrument which will put the coal-mining industry on its feet. Essentially the plea was an admission that the fuel problem demands scientific treatment as an organic unit by the best brains of the country, unfettered by political ties.

In closely related industries the same story of the fundamental dependence of industrial progress upon scientific research is told. Long and patient investigations led Ludwig Mond to the discovery of nickel carbonyl, and the remarkable progress in the metallurgical industries during the last two decades is also based on purely scientific investigations—metals such as tungsten, molybdenum, vanadium being little more than curiosities when they were discovered. The 'Silal' heat-resisting alloys developed by the Cast Iron Research Association are finding a number of successful uses in industry, and it is claimed that the application of the knowledge of moulding sands and refractories acquired as a result of the Association's investigations represents an estimated saving to the industry of about £100,000 a year. Important advances in our knowledge of aluminium castings have come from the investigations of the Non-Ferrous Metals Research Association, while the investigations carried out by the British Refractories Research Association to improve the durability of refractories react on developments in the ceramic, the iron and steel, and other industries concerned with high temperature operations.

Much has been written in recent years on the dependence of the dyestuffs industry on scientific research and on the part which neglect of scientific research and development played in the decay of the British industry in the latter part of last century. It is, however, by no means generally realised that it was the rapid development of theoretical organic chemistry through the successive ideas of Berzelius, Gerhardt and Laurent, Liebig and Wohler, Dumas, unified by Cannizzaro, Williamson and Kekulé, which laid the foundations upon which the immense edifice of modern organic chemistry is based. Only in the order thus established could the significance of the fundamental discoveries, such as Perkin's mauve, the first azo dye of Peter Griess, Bayer's phthaleins and synthetic indigo, be appreciated and the development of dyestuffs, synthetic drugs, and other branches of chemical industry become possible.

These industries thus owe a double debt to science. Not only were these developments con... chemical science opening up the field ...ing some sort of order among the immensely complicated compounds of carbon, but also the fundamental discoveries leading to definite technical advances have frequently been made, often fortuitously, in scientific laboratories.

The renaissance of the British dyestuffs industry under the operation of the Dyestuffs (Import Regulation) Act is in itself a striking example of industrial development through the continuous intensive application of scientific research. Not content merely to tread in the footsteps of its foreign competitors, in 'caledon jade green', the 'duranol' colours for acetate rayon and the 'soledon' colours, the British industry has been responsible for three out of the five major discoveries in the chemistry of dyes in post-War years.

Moreover, it is interesting to note that, so far from the field being exhausted or its potentialities limited by the discoveries and developments of last century, although the main structure of organic chemistry has remained essentially unchanged during the last three decades, within that period the view that chemistry is a static science has been confounded by discoveries and industries in almost every branch of organic chemistry. The technical production of indigo essentially dates from the Deutscher Golstand Silberscheide-anstalt or Roessler sodamide fusion patent of 1901, the Sandmeyer process from indigo being still more recent. The oldest section of the dyestuffs field, the triphenylmethane or aniline colours formerly regarded as comparatively fugitive, was found in 1915 to be capable of yielding with phosphotungstic acid a series of lake or pigment colours of surprising fastness to light, whilst the azo section is still providing new dyes for overcoming the dyeing difficulties presented by the new synthetic fibres.

Closely parallel with the development of the dyestuffs industry is that of synthetic drugs and fine chemicals. Here again the industry may be traced back to much purely scientific work such as Kolbe's synthesis of salicylic acid, and its expansion has invariably been connected with external scientific work, like Knorr's discovery of antipyrine, Ehrlich's salvarsan, Fourneau's 309, Kraut's aspirin, Molle and Kleist's veronal, the isolation and synthesis of adrenaline, Banting and Best's isolation of insulin, Kendall's preparation of thyroxin and its brilliant synthesis by Harington. Pasteur's scientific investigations on yeast were prompted by a brewing difficulty and led him to the discovery of the whole theory of fermentation, the existence and action of bacteria, thence to the pasteurisation process, and finally to the discovery of the antitoxin of hydrophobia. These discoveries have not merely transformed the brewing, yeast, dairy, and cheese industries, but also have led to the rise of important new branches in the production by fermentation of solvents such as acetone and butyl alcohol. It would be difficult to measure the debt of either the fermentation industries or, indeed, of humanity to the scientific work of Pasteur.

Even in the older industries, scientific research has been responsible for revolutionary changes and developments. The art of soap-making has been

transformed into a science. Sabatier's observation of the hydrogenating properties of finely divided nickel is the germ from which has developed the industrial hydrogenation or hardening of oils and fats and innumerable processes in almost every section of organic chemistry, including the Berginisation process for obtaining liquid fuels from coal. Scientific investigations on nitrocellulose and cellulose acetate and their solvents have led to the discovery of lacquers which have not only revolutionised the paint and varnish industry, but also made possible the enormous expansion of the automobile industry. The leather substitute used extensively in upholstering motor cars has itself been produced as an outcome of the scientific investigation of nitrated cellulose. Equally important is the development of the whole rayon industry from scientific investigations and observations in the same field of cellulose—Chardonnet's discovery of nitrocellulose silk and Cross and Bevan's viscose. The technical possibilities of any one of these discoveries were scarcely dreamed of by industry when the first investigation was commenced. Finally, the great fertiliser industry, including the fixation of atmospheric nitrogen, is essentially based on Liebig's discovery of the superphosphate process and Lawes and Gilbert's patient investigations on the effect of fertilisers on plant growth.

The above brief review of the creative influence of science on industry might be extended by reference to the radio industry, which is similarly the outcome of the scientific researches of Clerk Maxwell and Hertz on the properties of the electric waves. The telephone originated with the experiments of Bell, and the cinematograph industry, the automobile, the aircraft, the synthetic ammonia industries, are all the outcome of fundamental investigations, the practical significance of which was undreamt of at the time, and each now gives employment to thousands of workers.

Admittedly, society must look to creative science for the best hope of an ultimate solution of the unemployment situation. Indirectly, therefore, the problem of unemployment is linked with the problem of fostering the most vigorous intellectual activity among scientific workers and attracting into the service of science the most able minds the present generation can provide. Conditions which tend to lower the standard of recruitment for the various branches of the profession of science may react dangerously upon the welfare of the community. If full contact is secured between the finest type of such scientific work and industry, a fertilisation of industrial research will result from which all branches of the community will benefit. So competent an observer as Prof. Henry Clay remarks in this connexion that industrial expansion takes place less as the result of the establishment of entirely new firms to exploit new processes and new demands than as a result of existing firms, which are making profits by the efficiency of their management, applying these profits to finance expansion in new directions. It would seem that only through the rationalisation of industry can creative science exert its full influence in expanding employment.

(To be continued.)

The Structure of Wind over Level Country *

ABOUT seven years ago, in connexion with the construction and navigation of airships, the Meteorological Office was called upon to conduct further investigations into certain problems of wind structure. The work was taken up with energy and ability by M. A. Giblett, the already distinguished young meteorologist who afterwards in 1930 lost his life in the ill-fated *R101*. The researches on wind structure were completed by members of the meteorological staff of the Royal Airship Works at Cardington, and the results are now issued in an impressive volume as Geophysical Memoir No. 54.

The data discussed in this memoir were derived mainly from four anemographs, three of which were set up at the corners of an equilateral triangle of 180 feet side—approximately the length of the airship *R101*—and a fourth at the middle point of one side of the triangle.

The instruments could be arranged to use recording drums turning at the normal rate, that is, once in 24 hours, or at 12 times the normal rate, or at 144 times the normal rate. A time-marking device could be set to operate simultaneously upon the individual records. The instrumental arrangements were in charge of B. C. V. Oddie; a complete description of the equipment, together with photographs and a discussion of possible instrumental errors, is given in Part I.

After that, the work falls naturally into two main branches—the facts of observation and the discussion of the observations. Parts II. and IV. contain results dealing respectively with the horizontal fluctuations in wind in time and space and with the variation of wind with height; seven appendices are devoted to the statistics, whilst the work, in all, includes no less than 95 figures, containing, in particular, reproductions of numerous records, ordinary, quick-run, and ultra-quick run. All this is a valuable store of information which probably will afford material for the discussion of further problems. The discussion in this work is contained mainly in Parts III. and V.

In Part III., C. S. Durst outlines an attractive theory of eddies. The gusts, lulls, and changes of direction in an air current are commonly ascribed to more or less circular eddies embedded in the general flow, but in the study of the ultra-quick runs it has been noted that "the wind velo[illegible] does not change regularly backwards and [illegible] between gusts and lulls, but that the [illegible]

* Geophysical Memoir No. 54. By the late M. A. Giblett (Superintendent of the Airship Division of the Meteorological Office), and other Members of the Staff of the Office. Pp. 119 and plates xxi. (London: H.M. Stationery Office.) 10s. net.

rapidly to a maximum (the gust), then falls off slowly to a minimum (the lull), and superposed on this general change there are many smaller irregular oscillations". Moreover, "the main gust and lull do not affect the direction greatly; in fact, the changes in direction produced by the rapid irregularities are as large if not larger than the changes produced by the main gust and lull". Of these two types of disturbance, the first-mentioned varies in magnitude according to the gradient of temperature in the vertical direction, and tends to vanish under conditions of extreme stability. This large scale type of disturbance Durst associates with convectional eddying in cells of a depth of perhaps 1500 feet, of length in the direction of the wind of the order of 3000-8000 feet, and of a width of perhaps 600-2000 feet. The small scale disturbances he considers to be of frictional origin, eddies set up by contact of the air stream with the surface of the earth; the diameters of these frictional eddies are of the order of 50-100 feet, and the axes may be oriented in all directions.

In Part V., A. F. Crossley takes up the discussion of the effect of the present theory of eddies on the variation of wind with height, and finds that simple equations of motion can be applied to the atmosphere only above a height of 1500 feet if super-adiabatic conditions are present in the surface layer, and above about 50 feet when there is an inversion.

A. H. R. G.

Sadi Carnot, 1796–1832

On Aug. 24, 1832, a hundred years ago, Sadi Carnot, the author of the famous memoir "Réflexions sur la puissance motrice du feu et sur les machines propres à développer cette puissance", died in Paris at the early age of thirty-six years. For some weeks previously he had been very ill with fever, and was only just beginning to recover when he fell a victim to the cholera epidemic which claimed some 18,000 persons in Paris alone.

Little notice was taken of Carnot's death, and no one realised that he had made a contribution to science which was destined to render his name immortal. His essay had been printed in 1824 by the minor Parisian publisher Bachelier, and had it not been for the comments on the views of Carnot by his countryman, Clapeyron (1799–1864), the engineer, who in 1834 wrote a paper entitled "Sur la théorie méchanique de la chaleur" for the journal of the École Polytechnique, it might well have been lost sight of altogether. It was Clapeyron's essay which attracted the attention of Kelvin when studying in Regnault's laboratory in 1845, and it was Kelvin who first mastered the principle enunciated by Carnot; as he was also the first to realise the merits of the work of Joule.

Carnot's essay was reprinted in 1871 in the *Annales scientifiques de l'École Normale supérieure*, and in 1878 it was again reprinted by the publishers Messrs. Gauthiers-Villars, together with a letter from Carnot's brother Hippolyte (1801–88) to the Paris Academy of Sciences, dated Nov. 30, 1878, a biographical sketch and extracts from Carnot's manuscripts. The centenary of the publication of the essay was celebrated at the P.N. Russell School of Engineering, University of Sydney, on Oct. 23, 1924; and again on Jan. 20, 1926, at a special meeting of the Société des Ingénieurs Civils de France, which was attended by the President of the Republic and many officials, savants, and engineers.

Except for two incidents, the life of Carnot [illegible] uneventful. He was born in Luxemburg on [illegible] 1796; but before he had reached manhood, [illegible] been overthrown, and a career which might otherwise have been spent on the battlefield was passed in the barracks and the study. He was taught mathematics by his father, and attended the Lycée Charlemagne; in 1812 gained admission to the École Polytechnique, and in October 1814 passed into the Corps of Engineers at Metz. Earlier that year he had, with his fellow students, served in a battalion formed for the defence of Paris, but he saw nothing of active service. For five years he was employed on routine work in various towns; in 1819 he entered the staff corps in Paris, in 1827 was made a captain of engineers, and the following year retired from the army.

A born student, Carnot when in Paris followed courses at the Collège de France, the Sorbonne, and the Conservatoire des Arts et Métiers, his scientific studies being interwoven with others on music, the arts, literature, and political economy. He made himself familiar with mechanical engineering and various industries, and it was the absence of any exact theory of the steam-engines of Newcomen, Watt, Smeaton, and Trevithick which led him to the study of heat and to writing his "Réflexions". Towards the end of his life he joined the Association polytechnique started by old students of the École Polytechnique for popularising knowledge, and had he lived longer he would no doubt have taken a prominent part in its proceedings.

Carnot came of a celebrated family of Burgundy, his father being Lazare Nicolas Marguerite Carnot (1753–1823), the mathematician and engineer who earned for himself the title of "the organiser of victory". Nicolas Leonard Sadi Carnot was his second son; an older one who had also been given the name of Sadi, after a thirteenth century Persian poet, died in infancy. Hippolyte was the third son, while his son was Marie François Sadi Carnot, who became President of the French Republic and was assassinated at Lyons on June 24, 1894.

Of the character of Sadi Carnot, his brother gives a pleasing sketch. Energetic, courageous, with few prejudices and many amiable qualities, Carnot left behind him manuscripts which not only contain

his ideas on heat, gases, vapours, and such matters, but also his thoughts on conduct and life. Thus he writes, on various occasions:

"Régler le matin l'emploi de sa journée et réfléchir le soir à ce qu'on a fait."

"La promptitude des résolutions s'accorde le plus souvent avec leur justesse."

"Parler peu de ce qu'on sait et point du tout de ce qu'on ne sait pas."

"La vie est un passage assez court. Je suis à la moitié du chemin. J'achèverai le reste comme je pourrai."

"Les lois de la guerre, dit-on; comme si la guerre n'était pas la destruction de toutes les lois."

Carnot had had an uncle, a magistrate who, stricken with apoplexy in court, had exclaimed, "Vous allez voir comment on passe courageusement de la vie à la mort". It was in that spirit that Carnot had faced the long illness which led to his own death.

Obituary

MR. GEORGE BARROW

MR. GEORGE BARROW, who died at his home in London on July 23, at the age of seventy-eight years, was a well-known geologist, who served for thirty-nine years on the Geological Survey of Great Britain. His earliest work was carried on in the north of England, especially in north Yorkshire. Afterwards he was transferred to Scotland, where he spent many years in surveying the southern Highlands, especially Aberdeenshire, Kincardineshire, and Forfarshire. This work brought him into prominence and placed him in the first rank of British authorities on metamorphic rocks and the tectonics of ancient crystalline provinces.

In 1900, Barrow returned to England and was entrusted with the mapping of parts of Cornwall and Devon, including Bodmin Moor and the southern flanks of Dartmoor. On his promotion to District Geologist in 1909, Barrow took charge of work in the London district, and interested himself greatly in economic geological problems, such as water supply and underground railways. He retired from the Geological Survey in 1915, and thereafter devoted his energies, to a considerable extent, to the local administration of the district in which he lived.

In his official work, Barrow was responsible for contributions to a large number of maps and memoirs published by the Geological Survey. Of these we may mention Cheadle (1903), Whitby (1882), Braemar (1912), Blair Atholl (1905), Scilly Isles (1906), Tavistock (1911), Bodmin (1909), Dartmoor (1912). This list might be considerably extended, but is sufficient to indicate the variety of his work. He was an active member of the Geological Society, the Mineralogical Society, and the Geologists' Association, served on their councils, and published papers in their transactions. In 1912 he received the Bolitho Gold Medal from the Royal Geological Society of Cornwall, and in 1913 the Murchison Medal from the Geological Society of London.

Barrow was a remarkably original field geologist, with a very acute eye for surface features and their relations to geological structure and history. His work on the high-level platforms of the west of England and the Pliocene features of the country around London is a good example of this. He was exceedingly painstaking and thorough, and was one of the first in Britain to perceive the importance of microscopic investigation of the older crystalline rocks. Working under the influence and tuition of Allan Dick, he applied these methods to Scottish Highland problems and obtained results of great value. In this he was really a pioneer. He was endowed with constructive imagination and a wonderful intuition, which led him often to arrive at conclusions very rapidly and in a manner which even his colleagues had some difficulty in understanding. Yet often these hypotheses, which seemed at first mere guesses, turned out to be sound. Consequently he had a very stimulating personality, and his conversation on geological topics was very inspiring, especially to younger men who had not his wide experience in the field. A genial companion and a generous opponent, he knew how to enjoy life, and retained his wide outlook, his courage, and his enthusiasm to the end of his days.

J. S. F.

MR. R. STAPLES-BROWNE, M.B.E.

RICHARD STAPLES-BROWNE, of Butler's Court, Alvescot, Oxfordshire, who died on June 5, was born in 1881, and from Rugby School went up to Emmanuel College, Cambridge, taking his degree by the Natural Sciences Tripos of 1902. He then commenced the medical courses, but the endocrine trouble which afflicted him throughout life called for a voyage round the world before he passed his second M.B. examination in 1906. About this time he came under the influence of William Bateson and relinquished medical study for biology, always his chief interest.

Staples-Browne's experimental work on inheritance in pigeons is among the best pioneer studies engendered by the rediscovery of Mendel's papers; he showed that Darwin's inquiry into the origin of the domesticated races of pigeons was unnecessarily complicated, and that his results are capable of simple explanation on Mendelian lines. Sex-linked heredity in doves was demonstrated by Staples-Browne just after this important condition had been discovered in poultry, and he may be said to have laid the foundation of our genetical knowledge of pigeons. During the War he joined up with the Medical Corps of the New Zealand Expeditionary Force, and, with the rank of captain, he did four years' service in its clerical and statis[illegible] branches in England, for which he wa[illegible] the M.B.E.

Descended from a long Oxfordshire ancestry, Staples-Browne inherited a country gentleman's love for ornithology, fishing, and shooting, but biological research was always foremost, and up to his last illness he was planning improvements in the laboratory which he added to the Tudor house he had modernised during the happy married life of his later years. He will be remembered as a most loyal friend, for his charming and courtly manner, for his wide interest in life, and for an early developed power of shrewd criticism in biological subjects. Hampered by long periods of bodily discomfort and occasional disabling illness, the amount and intrinsic value of his contributions to inheritance are a remarkable record of enthusiasm and moral courage defeating odds which would cause most men to relinquish original work.

WE regret to announce the following deaths:

Prof. J. C. Fields, F.R.S., research professor of mathematics in the University of Toronto, president in 1924 of the International Mathematical Congress, on Aug. 9, aged sixty-nine years.

Dr. T. H. Gronwall, known for his mathematical works, especially on theories of elasticity and differential and integral equations, on May 9, aged fifty-five years.

Dr. George F. Kunz, known for his work in mineralogy in the U.S. Geological Survey, and especially for his work on precious stones, on June 29, aged seventy-five years.

Capt. Poulett Weatherley, one of the earliest explorers of Northern Rhodesia, the Belgian Congo and Tanganyika Territory, and the discoverer of the source of the Congo, aged seventy-two years.

News and Views

Archæological Research and Government Control

A RESOLUTION of the first International Congress of Prehistoric and Protohistoric Sciences recently held in London expressed deep regret at the attitude of the Egyptian Department of Antiquities in putting obstacles in the way of the scientific study of Egyptian prehistory; and while expressing respect for the rights of the Egyptian nation to preserve and arrange its documents, requested the Egyptian Government to ensure facilities for study and precautions against action detrimental to research. The opinion of British archæologists, that the attitude of the Department towards archæological exploration by extra-territorial investigators is not in the best interests of science, has frequently been brought to the notice of the Egyptian Government. A resolution which expresses the opinion of a body so widely representative as an international congress may perhaps carry conviction that dissatisfaction with the methods of the Department is not merely the view of sectional interest.

THE situation is admittedly a difficult one. Nor does Egypt stand alone. Similar difficulties are bound to arise whenever a country which calls for exploration in the interests of archæological science is neither financially competent nor intellectually equipped to undertake such exploration on its own behalf. Preservation of finds intact and accessibility of the material for the purpose of study are also important factors in the situation. Archæological investigation unquestionably is being checked in several directions in present conditions. Financial assistance, which in any event is difficult enough to obtain at the present day, is being still further restricted by the uncompromising attitude of those in authority, who are in a position to dictate conditions. The institution of a body such as the Congress of Prehistoric and Protohistoric Sciences, which is above sectional interests, would seem to afford opportunity for the formulation of a settled policy which would reconcile, on an equitable basis, [illegible]ims of scientific study and research and the [illegible]tional authority, even with the admitted [illegible] other things being equal, national antiquities are best preserved, exhibited, and studied in their own regional environment.

Future Research Work in Prehistory

BEFORE rising, further resolutions were adopted by the Congress of Prehistoric and Protohistoric Sciences. The invitation to hold the next meeting at Oslo was accepted; and the president-elect, Prof. A. W. Brögger, of Oslo, who has acted as joint general secretary of the first meeting, was inducted into the chair by Sir Charles Peers, the retiring president. It was then resolved that research committees should be appointed to investigate specific problems and carry out certain specified pieces of work. One committee will investigate the relations which subsisted between the Ægean world and the Balkans and Danubian countries. Another is to study problems related to the civilisation of the western Mediterranean. Prof. Gordon Childe has been entrusted with the compilation of an international vocabulary of technical terms in archæology, with the co-operation of all countries represented at the Congress; while it is an instruction to the organising committee of the next Congress to investigate the possibility of a report on the systems of classification adopted by different schools of archæology.

Dental Mutilation in Early Times

ON page 284 of this issue we publish a summary of Sir Arthur Keith's report to the first International Congress of Prehistoric and Protohistoric Sciences on the human skeletal remains discovered by Miss Garrod in Palestinian caves in association with a mesolithic culture. The report directs attention to certain cultural practices for which the skeletal material affords evidence, such as the evulsion of the upper incisors and the practice of cannibalism. In the discussion which followed the presentation of the report, Prof. Elliot Smith expressed doubt as to chronology, and questioned the high antiquity of the practices to which Sir Arthur had referred the conditions observed in the skeletal material. In a letter on the Oldoway skeleton, which appears in the August issue of *Man*,

Prof. Elliot Smith, writing before the positive evidence pointing to the recent origin of that specimen was available, argues that the cultural evidence, upon which reliance had been placed in support of the antiquity of the remains, in effect tells against it. In particular, he maintains that the deformation of the teeth exhibited by Oldoway man, a filing away of the anterior surface of the lower incisors, first appears, with other forms of dental deformation, in human remains from a Ptolemaic-Roman cemetery near Dacca, in Lower Nubia, recorded by Dr. D. E. Derry and himself. He suggests, further, that the process of filing was the original device for removing the teeth, and was almost immediately superseded by lateral filing, or the more drastic evulsion. Therefore, he thinks, the practice of dental mutilation was not introduced before about 300 B.C. In this connexion we may direct attention to the recently published account of the fossil man of Asselar (Sahara) by MM. Boule and Vallois (see p. 280), in which the authors interpret the condition of the upper jaw as due to the evulsion of the upper incisors in early life, and refer to a similar condition in the fossil human remains of Afalou-bou-Rhummel (Algeria). The apparent age of the Asselar man at the time of the operation conforms to its generally accepted relation to puberty ceremonial; while the geological and palæontological evidence, if correctly recorded and interpreted, points unquestionably to a Pleistocene dating.

Radio Communication with very Short Waves

IT is announced in the *Times* of Aug. 15 that the experiments which are being carried out by Senator Marconi on communication by means of radio waves of very short wave-length have been successful. As communication was established between two places 170 miles apart, and as the wave-length he used was only 57 cm., the result is of great importance. Hitherto it has been considered impracticable to use such short wave-lengths for transmission owing to the curvature of the earth. The experiments prove that the range of communication with very short waves must extend much farther than the visible horizon. Many experiments, including some by Marconi himself, using very short waves, have been made previously in attempts to reach stations beyond the visible horizon, but all proved unsuccessful. The apparatus now used is of low power and is fitted with portable reflectors. In the recent tests, clear communication was established from Rocca di Papa, near Rome, to Cape Figari, in Sardinia. The transmitting apparatus is quite light, and can now be easily transported anywhere. Formerly the apparatus used was very heavy and cumbersome. It will be of great scientific interest to learn the greatest distance over which this new method can be used.

West Indian Hurricane Season

IN connexion with recent reports that a hurricane has swept along the Gulf coast of the United States, it may be noted that August is the first of the three months into which a very large proportion of West Indian hurricanes is concentrated, and that at least one of these tropical cyclones occurs in that month rather more often than not. Most of the storms that arrive early in the hurricane season sufficiently far west to cause serious damage in Texas, as has happened in the present instance, enter the mainland moving north-westwards and then northwards along a characteristically curved path, and begin to diminish in intensity on leaving the sea, but a great many of the August storms first appear farther east and pass across or to the east of the Florida peninsula. It is not yet possible to gauge the exact path followed by the recent storm, but Galveston and Freeport and, to a less extent, Houston were all affected by it. The deaths caused by it have apparently not been very numerous, considering the large amount of material damage, a fact which is attributed to the timely evacuation of the coastal lowlands. This suggests that the section of the forecast service of the United States Weather Bureau which issues hurricane warnings for the Gulf region deserves great credit for effective warnings issued in good time to be of practical service.

Laboratory for Freshwater Biological Research on Windermere

THE laboratories of the Fresh Water Biological Association's Station at Wray Castle, Windermere, were opened to public inspection on Aug. 10. A succession of microscopes was used to show the consecutive life stages from the plankton or microscopic plants through equally microscopic insects to the smallest fish. Exhibits, in tanks, of the small fish which feed on these and of the larger fish completed the life series. In addition, there were tanks containing leeches, fly larvæ, fish-like stage of the newt, and so on. The uses of nets and grabs for obtaining samples of life, water, and bottom material were also demonstrated. Diagrams showed the relations between wind direction, shoals, and the quantity of life, and the consequent variation in the number of fish an angler might catch. An ingenious and newly evolved apparatus involving a light-sensitive potassium cell and a two-valve amplifier, used in the evaluation of the light intensity at various depths, was shown. Research in progress was represented by an ingenious apparatus enabling the researcher to discover the variation in velocity with which a tape worm moves against, or with a constant current. The same water was circulated continuously, but owing to the necessity of keeping it untainted by metals it was pumped round by a water-suction pump. In addition there were numerous cultures of fly larvæ, which are being bred in order to discover which flies develop from named larvæ—flies and larvæ having been originally named irrespective of their relationship. The Fresh Water Biological Association is to be congratulated on the excellent arrangement of the laboratory, and on the great enthusiasm of the staff, and—a most encouraging sign—of the youthful and very keen body of research workers gathered together there.

Dungeness Preservation Fund

THE promontory of Dungeness is unique south-east coast of England as being area of any size remaining in a nat

state. It is of particular interest for its bird life, notably as the sole British breeding ground of the Kentish plover. Other uncommon birds also nest there, such as the stone curlew, and there is a large colony of terns. All this may soon be irretrievably lost if a threat of bungalow building along the sea-front cannot be averted. To secure the position, therefore, efforts are being made to raise £9000 for the purchase of 271 acres as a bird sanctuary and Nature reserve, to be administered either by the National Trust or by the Royal Society for the Protection of Birds. This area, with its half-mile of shore frontage, is the part immediately in danger, and its price is, unfortunately, already that of a building site. Its acquisition, however, would increase the sanctuary value of adjacent land that is already preserved, and would make inaccessible to development a further stretch of coast lying beyond. The area is thus a key position, and the success of the scheme for its security is very greatly to be desired. The treasurer of the fund is Mr. Percival Jackling, Lloyds Bank, Folkestone.

The Grid and the Cost of Electricity

In connexion with Sir Archibald Page's speech, a résumé of which was given in Nature of Aug. 6, p. 212, Col. H. L. Crosthwait, late R.E., writes asking whether the advent of the 'grid' is likely to reduce the price of electricity or not. So far as can be seen at present, it will reduce the price to numerous consumers. The large stations recently built are generating electricity with far greater economy than the older stations which they replace. The use of the grid will be a great help in securing continuity of supply, and will make it unnecessary to keep a large number of costly machines in reserve in case of breakdowns. The standardisation of the pressures and frequency of supply has cheapened the cost of machines, apparatus, and lamps. We have not heard complaints from any consumer that the electricity companies have been raising the price of electricity; on the contrary, many of them have recently made substantial reductions. It is probable that some consumers will be little affected by the advent of the grid, but many will get their electricity cheaper, and very many dwellers in towns and villages will be able to get electric light and power which they otherwise would not have obtained. The grid is the logical engineering outcome of Ferranti's scheme for lighting London, using electricity at high pressures, first put into operation about forty-four years ago. Its critics have suggested nothing better; as a rule, they desire progress to be made by costly competitive methods. In the future the grid will probably be considerably modified, but at present consumers can look forward to a gradual lowering of the price of electric light and power.

Monument to Otto Lilienthal

On Aug. 10 a monument to Otto Lilienthal, the ...man pioneer of gliding flight, was inaugurated at ...hterfelde, Berlin, on the mound from which ...de many of his flights forty years ago. ... was piled up for the purpose by Lilienthal, is some forty-nine feet high, and a photograph taken some years ago shows its sides covered by shrubs and the top surmounted by a small temple-like construction consisting of pillars supporting a slightly sloping round roof. According to the *Times* for Aug. 10, the mound has now been cleared of the trees and shrubs, while in the monument at the top, and beneath the central opening in the roof, is a silver globe inscribed with particulars of famous flights. The globe is mounted on a basalt block. A photograph of the inauguration of the memorial appeared in the *Times* for Aug. 11. Lilienthal was a successful engineer and manufacturer. He was born on May 23, 1848, at Anklam and died on Aug. 10, 1896, at Rhinow through an accident while gliding. Another monument to Lilienthal was inaugurated at Lichterfelde in 1914. This consists of a stone pyramid, bearing on one side a bust and on the summit a figure of a man with outstretched arms supporting a pair of wings.

The Workers' Educational Association and Science

At the Annual Conference of the Workers' Educational Association last year, it was resolved "to investigate the possibilities of stimulating further interest in the study of science [that is, natural science] on a non-vocational basis", and the result of the investigation by the Executive Committee has now been circulated. To a scientific worker, it seems in some respects a strange document to be produced in 1932. It says, "The Adult Education Movement cannot afford to neglect scientific thought and knowledge. Ignorance of the influence of science should belong to the past"; and then, "The study of science, in some of its branches, provided the approach is of the right character, is as attractive and has as great a bearing on social conditions as some of the social sciences". As if the very foundations of social conditions did not rest upon heredity, and health, and the fight against disease, and the production of food, whether from the fisheries or agriculture, and the growing of the raw materials of commerce, and the constant battle against pests, whether they be parasites or plagues, and upon life itself! The Report says, further, "It is only in relation to the question as to how far and in what ways natural science influences and affects society, that our classes can maintain their interest in subjects of this character". It is on strong ground, however, in holding that the teaching of natural science, in so far as it is to be promoted, should avoid the formal lines of a university degree course, and should be of such a character as to attract the uninitiated.

The Committee, basing upon its district reports, finds that "there is a lack of interest so far as the adult population is concerned in the study of science". We think this may be due partly to the ignorance of people as to what natural science means, and partly to the failure to offer suitable courses. But we congratulate the Committee on its unanimous opinion "that the Association should seek to stimulate further interest amongst adult students in the study of science on a non-vocational basis". Towards this end it makes several recommendations, of which the most

promising seem to be the organising of district panels of suitable lecturers, the inclusion of provisional science courses in the programmes of classes, and propaganda to encourage interest in the study of science, by printed leaflets and by peripatetic lecturers capable of interesting popular audiences. Two interesting "general recommendations" are added: that there should be "a rapid and progressive improvement in the supply of films and slides applicable to science teaching", and that for this purpose "the Association should investigate the possibilities of the setting up of a national organisation for the production and distribution of educational films".

The Science Museum during 1931

THE Report of the Advisory Council of the Science Museum of 1931 is the first issued since the Council was reorganised on lines suggested by the Royal Commission on National Museums and Galleries. With Sir Richard Glazebrook as chairman, the Council now includes three representatives appointed by the Board of Education, and twenty-six representatives of various scientific, technical, and industrial institutions. The Royal Commission also recommended that the Advisory Council should be assigned a more active part in the management and development of the Museum, and the adoption of this recommendation has already resulted in the appointment of a Standing Committee which will meet four or five times annually, and of three small sub-committees which are to report on the Science Library, the development of the Electrical Engineering Section, and on an exhibition of pottery and porcelain manufacture. The Report contains details of the attendances, lectures, temporary exhibitions, acquisitions, and of the Library. It also contains a tribute to the late Sir Hugh Bell, who was chairman of the Advisory Council from 1912 until 1931, and to the Director, Sir Henry Lyons, and his staff. Among the acquisitions during the year are the apparatus used by Sir William Ramsay in his work on the rare gases of the atmosphere, the fine collection of optical instruments, numbering nearly 600, given by Mr. T. H. Court, and the cinematographic apparatus invented in 1887–89 by Louis Augustin Le Prince, who disappeared while travelling in France in 1890.

Safety in Mines

THE Safety in Mines Research Board has just issued Paper No. 74, which contains an account of an important conference on safety in mines held at Buxton last year. There seems no adequate reason why information about this important conference should have been so long delayed, though there may have been difficulty in getting the authors of the various papers to correct their contributions. The meeting derives its great importance from the fact that it was the first international conference of this kind. In addition to the British representatives, there were delegates from Belgium, France, Germany, and the United States. A number of important papers on mining explosives were read, and proposals were made for future international meetings, subject to ratification by the organisations concerned—a ratification which, we presume, will certainly be forthcoming. Perhaps the most important of the suggested future arrangements was that "Periodical meetings of the directors of research shall be arranged at each research station in rotation". This arrangement would thoroughly ensure the international character of future conferences, and it is a most welcome sign that the question of safety in collieries is for the future to be treated as an international question and not as one possessing local interest only.

Geodetic Surveying in the United States

THE annual report of the Director of the United States Coast and Geodetic Survey for the year 1930–31 (Washington, 1931, 45 pp., 60 cents) describes briefly the wide range and large extent of the activities of this important and progressive organisation. It has as a frontispiece a photograph of the new surveying vessel (one of several possessed by the Survey) *Hydrographer*, commissioned in March 1931, and fully equipped with sound-ranging apparatus for depth-surveys; sound-ranging is also used for locating the position of the ship from the shore at the time of each depth-measurement. The use of these methods has greatly increased the rapidity of the coastal survey work. The control survey work on land has also been rendered much more rapid and less expensive by abandoning the erection of the large wooden towers formerly used in flat or rolling country, at points about ten miles apart, to enable the observers to see across such distances over intervening trees and other obstructions. These towers were often 100 feet or more in height, each being double, so that the observer could walk on the outer platform, unconnected with the inner tower carrying the instrument. They contained large quantities of material, used once only, and required much time to erect. They are now replaced by portable steel towers, which can be erected by five men in less than a single working day, and used many times, their transport from one place to another being made by trailer trucks. An improved and smaller theodolite has also been devised and brought into use.

Czechoslovakian Contributions to Science

THE scientific communications to the Czech Academy of Sciences during 1928 and 1929 have now been published in French or English in volumes 29 and 30 of the *Bulletin International* of the Academy. Among the papers presented are several by Dr. F. Němejc dealing with his palæobotanical investigations on some quaternary deposits in the district around Ružomberok in Slovakia. Dr. R. Kettner has made a similar study of the geological formations in the Hron Valley, and Prof. Ulrich describes the minerals variscite and barrandite from Třenice and also a Slovakian rutile. Dr. J. Hahn's account of the life history of *Monocystis Mrazeki* is illustrated with some fine photomicrographic plates, whilst M. Uher's communication dealing with the genesis of nerve elements cultivated *in vitro* is similarly illustrated. D[illegible] Jirovec has succeeded in observing and re[illegible] a coloured plate some twenty stag[illegible]

division of *Trypanosoma evansi*. His observations apparently contradict the earlier ones of Roskin. In pure chemistry, Prof. Tomiček and Dr. Janský have made an exhaustive study of the methods available for determining mixed halides in connexion with the analyses of bromides and iodides in spa and thermal waters. The improvements which they have introduced enabled them to give more accurate and detailed results. It was long supposed that the waters from Darkov, Silesia, were the richest in iodine, but according to these authors the waters from Čiz in Slovakia and Bad Hall in Austria are still richer, with a total iodine content of more than 28 mgm. per litre.

Colloid Aspects of Textile Materials

A GENERAL discussion on "The Colloid Aspects of Textile Materials" has been arranged by the Faraday Society to be held in the Department of Chemistry of the University of Manchester on Sept. 21–23, under the presidency of Sir Robert Mond. An introductory address will be given by Prof. F. G. Donnan. The general subjects to be discussed include cellulose and its derivatives, lignin and keratin; fibre particles, their production, deformation, and degradation; and manufacturing processes. Among the foreign guests who will speak at the discussion are: Prof. H. Mark (Ludwigshafen), Prof. H. Staudinger (Freiburg), Dr. S. E. Sheppard (Rochester, U.S.A.), Dr. J. J. Trillat (Paris), Prof. K. Freudenberg (Heidelberg), Prof. O. Roehrich (Paris), Prof. Herzog (Berlin), Prof. J. R. Katz (Amsterdam), Mr. C. R. Nodder (Lambeg), Prof. E. Elöd (Karlsruhe), and Prof. P. Krais (Dresden). Further particulars of the meeting can be obtained from The Secretary, Faraday Society, 13 South Square, Gray's Inn, London, W.C.1.

Swedish Meteorology

THE State Meteorological and Hydrographical Service of Sweden has published as Part 2 of the Årsbok for 1932 the meteorological statistics of the country for the year 1929. The data are collected from more than two hundred stations, for each of which pressure, temperature, humidity, wind direction and force, cloud, and rainfall are given in three records on every day of the year. For some forty stations, monthly and yearly means are also given for each hour of observation. There is no discussion of the data, but the usefulness of this publication is enhanced by the headings and notes being given in French as well as Swedish.

Announcements

PROF. F. WOOD JONES, professor of anatomy in the University of Melbourne, will go to Peking as head of the Department of Anatomy at the Peking Union Medical College, during the absence of Prof. Davidson Black on leave in Europe and America during the next six months.

THE valuable collection of Australian Coleoptera, containing a great store of 'types', of the late Mr. Lea, who died at Adelaide on Feb. 29 (see May 28, p. 786), has recently been purchased by the Governors of the South Australian Museum, partly as a memorial of his work.

THE "Achema VII" (the German Chemical Plant Exhibition, Ausstellung für chemisches Apparatewesen), arranged by the "Dechema" (Deutsche Gesellschaft für chemisches Apparatewesen, of Seelze, Hannover), will be held at Cologne in 1933 (probably on June 2–11, 1933) at the same time as the conferences of the Verein Deutscher Chemiker, the Deutsche Kautschukgesellschaft, the Deutsche Brennkrafttechnische Gesellschaft, and the Dechema. Other scientific and technical societies will also hold their annual meeting at Cologne during the same period.

THE following awards for the year 1932–33 have been made by the Salters' Institute of Industrial Chemistry: Fellowships renewed to: D. J. Branscombe, University College, Exeter; H. G. Simpson, East London College; J. L. Sweeten, St. Catherine's College, Cambridge; P. Chisholm Young, Trinity College, Cambridge. Fellowships awarded to: S. C. Britton, Pembroke College, Cambridge; E. H. T. Hoblyn, Imperial College of Science and Technology; R. H. McDowell, Jesus College, Oxford; G. Pearce, University of Birmingham. The Salters' Institute has also awarded 107 grants-in-aid to young men and women employed in chemical works, to facilitate their further studies.

POPULAR science book lists, 27 in number, have been prepared by a special committee of the American Association for the Advancement of Science, aided by some 300 specialists in colleges, libraries, and museums. The object of the series is to offer to the general reader reliable guidance in the choice of a few elementary science books, and in following up such reading by systematic study. The lists are annotated, and cover the whole field of elementary physics and chemistry, natural history and physiography, the history of science, and the teaching of science.

THE Arctic Institute of Leningrad has prepared a new map of the polar areas of the Soviet arctic regions. The map shows the regions discovered by recent Soviet expeditions, and has been compiled in both Russian and English.

MESSRS. Watts and Co. announce the early publication of "The Universe of Science", by Prof. H. Levy, in which recent pronouncements of Sir James Jeans, Sir Arthur Eddington, and General Smuts regarding the universe are critically examined.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in metallurgy and applied chemistry at the Royal Naval College, Greenwich—The Adviser on Education, Admiralty, Whitehall, S.W.1. (Aug. 22). An assistant lecturer in engineering at the School of Mines, Treforest—The Director of Education, County Hall, Cardiff (Aug. 26). A de Beers professor of mining and surveying at the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner, South Africa House, 73 Strand, W.C.2 (Sept. 7).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Theory of Induced Polarities in Benzene

THE letter from Dr. E. and Prof. W. Hückel in these columns [1] explains that "H^+" on page 326 of Dr. E. Hückel's original paper was a misprint for "H-atom". The misprint, occurring at a crucial point, was unfortunate, and in the light of this explanation we naturally withdraw all such criticism as was based on the misapprehension that Hückel postulated extrusion of proton during the ordinary "substitution of hydrogen" in the aromatic series.

Our objections to Hückel's theory as we now understand it are no less serious than when our first letter [2] was written. E. and H. Hückel now say that "the assumption in Hückel's theory is . . . only that for a definite reaction the heat of activation is smaller for a hydrogen atom bound more loosely and greater for a hydrogen atom bound more strongly. It cannot be denied that for all simple substitution reactions which have been investigated *quantitatively* up to the present time, this assumption—taking the charge density calculated by Hückel—leads to results which are in agreement with observation."

We may point out that the apparent agreement is real *only if Hückel's additional assumption relating to the direct connexion between the strength of the* bond in C-H and the Coulombic attractive force on the nucleus of the H-atom can be justified. Even if it could be justified, it has not been shown that the few data quoted by Hückel are inconsistent with the theory of aromatic substitution which we support. In contrast to this state of things, there is a vast body of data which fit in most satisfactorily with our own ideas but not with Hückel's, and no better illustration of this statement is needed than the statement made by Dr. E. and Prof. W. Hückel that "We cannot see what connexion there is between the dissociation of acids and bases and substitution reactions in benzene".

That there is, nevertheless, a very close connexion between these phenomena has, we believe, been widely recognised, in English-speaking countries perhaps more particularly, since the publication of the classical paper [3] of Flürscheim on the subject, and although organic chemical theory has undergone revolutionary changes during the interval and many of the examples, such as aliphatic acids, quoted by Flürscheim are now considered inappropriate, the paper embodied a discovery of first-rate importance, which is only emphasised by addition of new examples that are even more convincing than those given by the discoverer.

We would direct attention first to the mono-substituted phenols. Adequate data for use in the above connexion are available only in three cases: (*a*) the cresols (methylphenols), (*b*) the dihydroxybenzenes (hydroxyphenols), and (*c*) the nitrophenols. Of the three cresols, the meta-derivative is the most acidic.[4] Of the hydroxyphenols, the meta-derivative has a higher ionisation constant than the ortho-derivative,[5] and partition measurements made in the laboratories of the University of Manchester prove that the meta-derivative is also a more powerful acid than the para-derivative. Of the three nitro-phenols, on the other hand, the meta-derivative is much the weakest acid.[6] These cases represent typical alternate effects as this expression is now most widely used, no reversals in sign being required or implied.

The significance of the data relating to the acidities of isomeric substituted phenols can best be appreciated by reference to a well-known generalisation illustrated by the following quotation from G. N. Lewis: [7] "If we consider corresponding hydroxides of nitrogen, phosphorus, arsenic, antimony, and bismuth, we see the effect of the diminishing pull of electrons by the central atom as we proceed from nitrogen to bismuth. The hydroxides become progressively weaker acids and stronger bases."

The application of this generalisation to the arrangement C – OH in isomeric phenols leads to the conclusion that, other things being equal, the acidity of the hydroxyl group will be most pronounced when the group is attached to that carbon atom in the neighbourhood of which the electrons are most under the control of the central system either of the carbon atom or of the aromatic ring as a whole—in other words, at the carbon atom where the negative charge density is least or the positive charge density is greatest. In the three trios of substituted phenols above mentioned, the data, combined with Lewis's generalisation, show that the distribution of the charge densities in E. Hückel's two pictures (*loc. cit.*, p. 301) must be incorrect.

Relationships between isomeric substituted benzoic acids are more complicated. Nevertheless, as was pointed out by Flürscheim, the ionisation constant of the meta-substituted acid is greater than that of the para-substituted acid when the substituent is of the '*o-p*-directive' type, while the converse is true when the substituent is of the 'meta-directive' type. This generalisation holds good for the chloro- and nitro-benzoic acids [8] cited by Dr. E. and Prof. W. Hückel in evidence against our views, and is quite independent of whether the acids are weaker or stronger than benzoic acid, a question which depends mainly on the magnitude and orientation of the dipole moment associated with the introduction of the substituent into the aromatic system.

Our idea that attachment of the substituting agent to aromatic carbon precedes elimination of proton and is not simultaneous with the latter process is admittedly not proved, but it has served as a useful working hypothesis which has helped to correlate known data and to foresee others. Our fundamental thesis is that substituting agents of the electron-seeking type, such as halogens, sulphuric acid and sulphuric anhydride, nitric (or nitrous) acid, enter *most readily* into reaction with those carbon atoms of the aromatic ring at which there is an electronic excess, whilst agents such as alkalis, amines, metallic cyanides and sulphites, which act normally through their anions or by using their own electrons to form new covalencies, enter into reaction *only* with aromatic carbon atoms at which there is a decided electronic deficiency.

A. LAPWORTH.

University of Manchester.

R. ROBINSON.

University of Oxford.

July 25.

[1] NATURE, **129**, 937; June 25, 1932.
[2] *Ibid.*, **129**, 278; 1932.
[3] *Trans. Chem. Soc.*, **95**, 718; 1900.
[4] Boyd, *ibid.*, **107**, 1538; 1915.
[5] Boeseken and van Rossem, *Rec. trav. Chim.*, **30**, 392; 1911.
[6] "International Critical Tables," **6**, 272; 1929.
[7] "Valence and the Structure of Atoms and Molecules," Chem. Soc. Monograph Series, 138; 1923.
[8] Ostwald, *Z. phys. Chemie*, **3**, 369; 1889.

Emulsification

IN 1925, Seifriz[1] made a number of interesting observations on the emulsification of hydrocarbon oils with water, using casein as emulsifier. He showed, for example, that oils ranging in density from 0·664 to 0·820 gave stable emulsions of the oil-in-water type; those of density 0·857 to 0·895 gave stable emulsions of the water-in-oil type; while oils intermediate in density gave emulsions which separated immediately. So far as we are aware, no adequate explanation of these results has been offered, but a simple explanation is possible on the basis of recent developments in the study of the liquid state.[2] The hypothesis to be advanced has important consequences for the theory of emulsification and detergent action.

Liquids are no longer to be regarded as structureless, and in the case of aliphatic compounds, the tendency to incipient crystallisation increases with the length of the carbon chain. The resistance to dispersion of liquids composed of long-chain molecules must therefore increase with the chain length, that is, in the case of the paraffins, with the density of the oil. Hence the inversion of emulsion type observed by Seifriz is due simply to the increased resistance to dispersion of paraffins of high molecular weight, caused by incipient crystallisation.

When oils and related compounds are spread as a thin film on a solid surface, the tendency to incipient crystallisation manifests itself in the form of adhesion to the surface. In this case, removal of oil by means of soap solution is conditioned by the magnitude of adhesion and interfacial tension, as shown by the following experiments.

A mineral oil was subjected to repeated fractional distillation to obtain nine fractions of increasing boiling point. Each fraction was then used to oil a wool fabric, which was afterwards scoured with soap and soda solution, using a standard mechanical technique. The amount of oil remaining in the fabric was found

Percentage by weight of Oleyl Alcohol in mixture.	Oil-water Interfacial Tension (dynes/cm.).	Residual Oil (per cent on weight of wool).
0·0	47·9	2·50
2·5	20·9	1·81
5·0	19·1	0·61
6·0	18·9	0·58
10·0	20·2	0·57
15·0	19·6	0·83
20·0	19·1	1·14
40·0	. .	2·20
55·0	16·1	2·88
70·0	15·5	3·25
85·0	14·7	3·36
100·0	14·4	2·66

to increase with the boiling point of the fraction, according to a law which indicates that the difficulty of removing oil increases in proportion to the length of the molecule.

Although the preceding results serve to indicate the importance of the adhesion factor, the difficulty of removing mineral oil from a solid surface such as wool is due mainly to high interfacial tension. Oleyl alcohol on the other hand, possesses a low interfacial tension, but is even more difficult to remove than mineral oil. This result must be referred to adhesion of a very high order, due to the polar character of the molecule and its high molecular weight.[3] Mixtures of mineral oil and oleyl alcohol are as a rule more easily removed than either oil alone. This important result discriminate between the two factors of interfacial tension, and is illustrated by the data of the accompanying table, obtained by oiling a wool fabric with 5 per cent by weight of each mixture, the fabric being then scoured as before, and the residual oil estimated by ether extraction.

As might be expected from the preceding results, both mineral oil and oleyl alcohol were found to be difficult to emulsify with soap solution, but the mixture of mineral oil and 6 per cent oleyl alcohol, for example, gave an extremely stable emulsion under similar conditions.

In conclusion, it is evident that the formation of emulsions, especially in the case of oils and related compounds of high molecular weight, is not determined simply by the magnitude of the interfacial tension and the formation of a stable adsorbed film at the interface. The cybotactic condition of the liquid to be dispersed is of equal importance in ordinary emulsification; while, in scouring processes, related adhesion phenomena acquire exceptional significance.

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N. H. CHAMBERLAIN.

Textile Chemistry Laboratory,
The University, Leeds,
July 14.

[1] Seifriz, *J. Phys. Chem.*, **29**, 587; 1925.
[2] Stewart, *Reviews of Modern Physics*, **2**, 116; 1930.
[3] Hardy, *Phil. Trans.*, A, **230**, 1; 1931.

Inhibition of Enzymes by Carcinogenic Compounds

EXPERIMENTS carried out in this laboratory[1] have shown that 1 : 2 : 5 : 6-dibenzanthracene and 5 : 6-*cyclo*-penteno-1 : 2-benzanthracene are the most carcinogenic of pure compounds yet described. The action of these compounds and of certain non-carcinogenic hydrocarbons on the oxidising enzymes of yeast and muscle has been studied. The carcinogenic and other hydrocarbons dissolved in benzene or toluene were shaken up with enzyme preparations, and the effect on the activity of the enzyme measured. In no case was indophenol oxidase of yeast or muscle affected by any such treatment.

The oxidation of lactate by lactic dehydrogenase of yeast or muscle was, however, inhibited by a dilute solution of the hydrocarbon in benzene or toluene which had been exposed to air and light. Exposure to air in the dark, or to light out of contact with air, was ineffective. Solutions activated by exposure to ultraviolet light became coloured yellow or brown and non-fluorescent. The amount of inhibition produced in this way on a yeast lactic dehydrogenase by several hydrocarbons treated in a comparable manner was as follows:

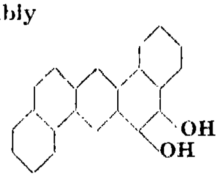
	Percentage Inhibition of Enzyme.	
Toluene control . . .	0	
(1) Anthracene	30	Non-carcinogenic.
(2) 1 : 2-Benzanthracene . .	28	,,
(3) Chrysene	26	,,
(4) 5 : 6-*cyclo*-Penteno-1 : 2-benzanthracene	55	Carcinogenic.
(5) 1 : 2 : 5 : 6-Dibenzanthracene	62	,,
(6) Polycyclic hydrocarbon from coal tar	74	More carcinogenic than (4) and (5).

In each case, 0·005 mgm. of the hydrocarbon was added to 1 c.c. of enzyme solution, which reduced 1 c.c. of 1/5000 methylene blue in the presence of lactate in 10 minutes at 40°. The maximum concentration of hydrocarbon is thus 1 part in 400,000.

The inhibitory action is greatest in the case of the carcinogenic compounds. The inhibition in the case of anthracene is not due to the presence of dianthracene, as this compound is quite inactive. **1 : 2 : 5 : 6-Dibenzanthracene was recovered unchanged after treatment which converts anthracene into dianthracene.**

The inhibitory factor was slightly soluble in water and more soluble in alkali, as was the colouring matter produced by exposure to light.

The chemical nature of the inhibiting factor is under investigation. It is possible that it is an *o*-hydroquinone; it does not appear to be an oxidation product in which *meso*-carbon atoms are involved. Comparison with reduced β-naphthaquinone and a reduced 1 : 2 : 5 : 6-dibenz-3 : 4-anthraquinone[2] showed the activity to be similar to that developed by the compounds named in the table above. The active compound derived from 1 : 2 : 5 : 6-dibenzanthracene is therefore possibly



Such a compound would have the structure $-\underset{|}{C}OH-\underset{|}{C}OH-$ which is similar to one of the groupings considered by Quastel and Wooldridge[3] to be necessary for the inhibition of lactic dehydrogenase. Full details of these experiments will be published shortly.

E. BOYLAND.

Research Institute,
The Cancer Hospital (Free), London,
July 28.

[1] The Production of Cancer by Pure Hydrocarbons, (Pt. 1) by J. W. Cook, I. Hieger, E. L. Kennaway, and W. V. Mayneord, (Pt. 2) by J. W. Cook, *Proc. Roy. Soc.*, B (in the press).
[2] J. W. Cook. Unpublished results.
[3] *Biochem. J.*, **22**, 689; 1928.

Isolation of Chemically Unstable Substances from Animal Tissues

IN the course of a study of some chemically unstable constituents of muscle tissue, we have made successful use of the following method for obtaining protein-free extracts of muscle. It has the merit of yielding, without departure from neutrality, a protein-free solution of the water-soluble constituents of muscle in a concentrated form. We have been unable to find a description of this technique in the literature, but should be grateful for information as to earlier examples of its use.

The method is based upon the facts that at 32° C. the solubility of sodium sulphate in water is at its maximum—50 gm. of the anhydrous salt to 100 gm. of water—and that if such a solution is cooled to 0° C., 96 per cent of the salt crystallises out as the decahydrate.

If muscle tissue, which contains water to the extent of 80 per cent of its weight, is minced with 40 per cent of its weight of anhydrous sodium sulphate, about three-quarters of the water of the muscle can be expressed without difficulty in the form of a saturated solution of sodium sulphate at 32° C. The solution contains no protein. The mother liquor poured away from this solution after chilling would be expected, on the basis of the figures given above, to contain the water-soluble constituents of the muscle in a concentration about three times greater than in the muscle. The following table, taken from a typical experiment, shows that this is the case.

The yield, unless special precautions are taken, is not very good—50-60 per cent—but in view of the ease and rapidity of the process and the high concentration of the extract, this is, for most purposes, not a serious drawback.

We have applied this technique so far only to the isolation of creatine, which can be precipitated immediately from the extract by addition of acetone, and of carnosine and anserine, which can be prepared from the extract by the use of copper carbonate,

	Concentration in Muscle. Mgm. per 100 gm.	Concentration in Na_2SO_4 Extract. Mgm. per 100 gm.	Concentration ratio.
Carnosine (by Pauli reaction)	35	112	3·2
Non-protein nitrogen	247	690	2·8
Lactate	250	700	2·8
Total phosphorus	118	303	2·6

acetone, and ammonia. The yield of crystalline copper carnosine or copper anserine compares favourably with the yields recorded by investigators using more elaborate methods. We have obtained in this way anserine from the muscles of sheep, goat, and rabbit, and carnosine from ox and frog muscle.

M. G. EGGLETON.
P. EGGLETON.

Physiology Department,
University, Edinburgh,
July 20.

Observations on Filmed and Filtered Vowels

SOME specimens of film curves of German vowels obtained by the Vienna method of recording (wire in magnetic field slantways across a slit[1]) are reproduced in Fig. 1. Inspection of the curves reveals the following facts: (1) A vowel is made up of a series of adjacent vibration profiles; (2) the profiles differ progressively in length, amplitude, and form; (3) each

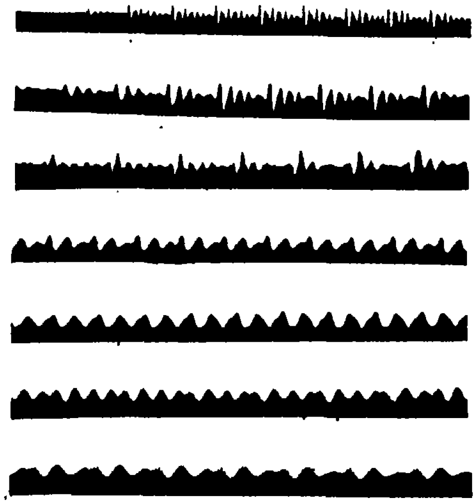


FIG. 1.—Film curves of vowels.

profile begins strong and becomes steadily weaker: (4) within each profile various characteristics, for example, maxima, are repeated; (5) different vowels show systematic differences of profile. Measurements reveal the following additional facts: (6) the frequencies of the inner repetitions change within each profile; (7) the rate of weakening changes within each profile.

These facts lead to the following conclusions: (1) The vibration profile is initiated by a sharp impulse that does not appear in the curve of the profile; (2) the profile consists of a more or less rapidly fading free vibration of complicated form.

The numerous systems of inner repetitions that the free vibration constituting the

be considered as the sum of a series of component free vibrations. Let us make this supposition and indicate the radian frequencies of the component vibrations by $\omega_1, \omega_2, \omega_3, \ldots$ Analyses of the profiles show that *all* the frequencies from 0 to ∞ are present to a greater or less degree. The profile is therefore not a sum of a few discrete free vibrations as ordinarily supposed, but an integration of an infinite number of such vibrations differing infinitely little from one another. The profile is therefore not a sum of discrete frequencies, but an integration over $d\omega$ between 0 and ∞. Each free vibration has a decremental index p. The analyses show that the decremental indices are infinitely variable, and that not one or a few but an infinite number of decremental factors are present between 0 and ∞. The decrement for each of the inner frequencies is therefore an integration over dp between the limits 0 and ∞. The amplitude of each inner vibration determines the amount of its contribution to the profile. The amount of the particular amplitude for a given frequency depends on the forces that control the formation of the profile. For a given profile it is determined by an integration over the particular frequency with the form of the profile $f(t')$ as amplitude within the limits α, β of the profile.

A complete expression for a vowel profile requires the formula:

$$y = f(t) = \frac{1}{\pi}\int_0^\infty d\omega \int_0^\infty dp \int_\alpha^\beta f(t')e^{-\omega p t'} \cos \omega(t' - t)dt'. \quad (1)$$

The change of the radian frequency and the factor of decrement as established by the measurements reported above require the additional equations:

$$\omega = f_\omega(t') \text{ and } p = f_p(t'). \quad . \quad . \quad . \quad (2)$$

The process that is expressed by formulæ (1) and (2) is a continuous affair that cannot be represented by any sum of discrete factors except as an approximation. A vowel profile is therefore unanalysable into a limited number of variables.

Equations (1) and (2) represent exactly what occurs in the vocal cavity. This does not consist of a set of cavities connected by orifices but of one cavity of complicated form that cannot be analysed into separate cavities. A sharp blow arouses a vibration that has every possible frequency between the limits of 0 and ∞. Just how strong each one of the infinitely numerous frequencies is depends on the shape of the cavity. The factor of decrement depends not so much on the inner work of the vibration as upon the softness and moisture of the walls of the vocal cavity. These may have any values. The shape of the vocal cavity is never constant for even the briefest instant; it is constantly and continuously changing according to the muscular movements that regulate it. These in turn are under the control of the various nervous and psychic centres that act in response not only to the speech impulse but also to the constant regulation by the entire nervous system and intellectual and emotional forces. This continual change results in the changes of inner frequency and decrement expressed by the equations in (2).

The essential characteristic of a vowel profile is its form. This view has recently received striking confirmation. At a recent demonstration by the British Post Office the attendant was good enough to carry out the following experiment. With a gramophone record of speech in connexion with a loud speaker various regions of frequency were filtered out as follows: (1) all frequencies above 1350; (2) all frequencies below 750; (3) all frequencies above 1350 and below 750; (4) all frequencies between 750 and 1350. The musical character of the speech changed with every change, but the specific characters of the vowels were unchanged. This leads to the rather startling conclusion that *the character of a sound as a vowel does not depend on the presence of any special frequencies.* The differences among the vowels therefore do not depend on the presence or absence of any particular tones or regions of tone. Any region of frequency assigned to any particular vowel can be filtered out with no change in the vowel except in regard to its musical character. Moreover, a small region of frequency anywhere is sufficient to give the vowel character. The conclusion cannot be avoided that the vowel character depends on the general shape of the vibration profile and that any frequencies of any kind may be present provided they give the same general form of profile. This would explain the otherwise unexplainable fact that a magpie with extremely small vocal organs of a kind different from human ones can imitate a man's voice so successfully.

The conclusion is inevitable that a vowel profile is a course of air vibration, muscular movement, nerve currents, and inner (psychic) activity. Any representation by a Fourier analysis, a physical analysis or synthesis, or otherwise into a limited number of variables can be only an approximation. A vowel profile, like a face profile, is recognised by its *form*; the one is a form in time, the other a form in space. Neither is recognised as a series of numbers. In both cases the form may be enlarged or diminished—the one in time (pitch), the other in space—without loss of recognition provided there is no distortion.

E. W. SCRIPTURE.

University of Vienna.

[1] See *Z. Experimental-Phonetik*, vol. 1, p. 96.

Diffraction of Gas Atoms

THE development of molecular ray technique makes possible investigations of the scattering of one beam of gas atoms by another. It is therefore of considerable interest to examine the conditions under which effects characteristic of the wave nature of the atoms would be observed. The angular distribution of the scattered atoms may exhibit maxima and minima, due either to the usual diffraction phenomenon or to the identity of the colliding particles if the atomic beams are composed of similar atoms.

We have therefore investigated theoretically the elastic collisions of two helium atoms with kinetic energy of relative motion (taken as kT) corresponding to temperatures of 20° C. and −185° C. respectively. For this purpose we have used an interaction energy given by Slater and Kirkwood,[1] and the theory of collisions due to Faxen and Holtsmark,[2] in which the scattered amplitude is given in relative co-ordinates by the series

$$f(\theta) = \frac{\lambda}{4\pi i}\sum_{n=0}^{\infty}(2n+1)(e^{2i\delta_n} - 1)P_n(\cos\theta),$$

the phases δ_n depending on the interaction energy and the energy of impact. λ is the associated wave-length.

For gas atoms a large number of terms of this series is required, and the evaluation of the phases by numerical integration of differential equations becomes very tedious. We have therefore used an approximate method of solution due to Jeffreys[3] for small values of n, and Born's approximation[4] for large values of n, intermediate values being given by interpolation. This method was tested by applying it to the calculation of the angular distribution of elastic scattering of 54 volt and 122 volt electrons in mercury vapour, good agreement being obtained with the experimental results of Arnot.[5] Since the completion of these calculations there has appeared a note by Henneberg,[6] who has obtained good agreement

with the experimental results for 135, 480, and 812 volt electrons by using a similar method.

In a co-ordinate system in which one atom is initially at rest, the number of atoms scattered between the angles Θ and $\Theta + d\Theta$ will be of the form $I(\Theta) \sin 2\Theta d\Theta$. The function $I(\Theta)$ obtained for the helium atom collisions is illustrated in Fig. 1, showing the existence of marked diffraction effects.

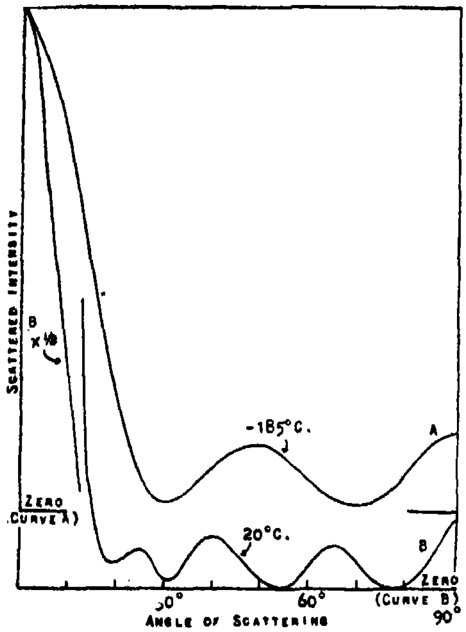


FIG. 1.—Angular distribution of function $I(\theta)$ for helium atoms scattered by helium atoms with relative velocities corresponding to temperatures of 20° C. and −185° C.

Allowance has been made for the identity of the helium atoms.[7] The collision diameter is very nearly the same for both relative velocities, being 2·4 A.

Unfortunately, direct experimental verification of these curves is difficult, owing to the necessity of obtaining monochromatic molecular beams. However, the effect should be apparent in the viscosity and other transport phenomena in helium. It is hoped to investigate this later.

H. S. W. MASSEY.
C. B. O. MOHR.

Trinity College, Cambridge,
July 25.

[1] *Phys. Rev.*, **37**, 682; 1931.
[2] *Z. Phys.*, **45**, 307; 1927.
[3] *Proc. Lond. Math. Soc.* (2), **23**, 428; 1924.
[4] Vide Mott, *Proc. Cam. Phil. Soc.*, **25**, 304; 1928.
[5] Arnot, *Proc. Roy. Soc.*, A, **130**, 655; 1931.
[6] *Naturwiss.*, **20**, 561; 1932.
[7] Mott, *Proc. Roy. Soc.*, A, **126**, 259; 1930.

The Velocity of Light

IN articles in NATURE and elsewhere, M. E. J. Gheury de Bray has proposed and defended the suggestion that the velocity of light may be a decreasing function of time, varying at present by about 4 km. a second a year. He bases this idea on an examination of the published results of measurements by a number of experimenters over a period of several decades, and concludes that all the results are in good agreement with his hypothesis.

I have obtained experimental proof that no such variability of velocity exists; the work was an offshoot of an investigation carried out at the California Institute of Technology to test whether time conforms to the requirements of the theory of relativity. An interference arrangement was employed in which the retardation of the interfering beams was 318 mm. or 582,000 wave-lengths of the mercury line used as the source. It proved feasible and easy to measure shifts in the interference pattern with a probable error of a thousandth of a fringe. This accuracy was attained by photographing the interference rings and comparing each photograph directly with a nearly identical one used as standard of reference for the whole series. The interference apparatus was built almost entirely of fused quartz and kept in a vacuum at an accurately controlled temperature, while the source, which was an electrodeless high-frequency discharge in unsaturated mercury vapour, was so contrived as to be free from spurious frequency shifts such as might result from Doppler effects, pressure variations, and so forth. The apparatus and procedure are described in detail in a paper entitled "Experimental Establishment of the Relativity of Time", by myself and E. M. Thorndike, to appear in the *Physical Review*.

The number of waves retardation in any interference arrangement is

$$n = \frac{\nu \Delta s}{c}$$

where ν is the frequency and c is the velocity of light, while Δs is the path-difference. If ν and Δs are supposed constant while c is a function of time, the rate of variation of n is thus

$$\frac{dn}{dt} = -\frac{\nu \Delta s}{c^2} \frac{dc}{dt}.$$

$\Delta s = 318$ cm., $c = 3 \times 10^{10}$, $\nu = 6 \times 10^{14}$, and according to de Bray's hypothesis $\frac{dc}{dt} = -4$ km. per sec. per year $= -1100$ cm. per sec. per day. Hence we should find

$$\frac{dn}{dt} = 0{\cdot}023 \text{ fringe per day.}$$

Three series of data were taken over periods varying from 8 days to a month, and the computed daily rates of change, expressed in thousandths of a fringe a day, are $0{\cdot}050 \pm 0{\cdot}020$, $0{\cdot}007 \pm 0{\cdot}013$, and $-0{\cdot}015 \pm 0{\cdot}021$. Their mean is $0{\cdot}014 \pm 0{\cdot}011$. This value stands in the ratio 6×10^{-4} to the amount required by the hypothesis of variable velocity, and of course definitely disposes of the possibility of it, unless the frequency itself is supposed to vary correspondingly.

ROY J. KENNEDY.

University of Washington,
Seattle, July 5.

Metabolic Rate and Habitat

WHILE innumerable adaptations in structure and habits of animals have been described, we have as yet little knowledge of the physiological causes and effects of distribution and habitat.

As regards metabolism, it is known that trout and mackerel, fishes confined to well-oxygenated waters, have hæmoglobins with a relatively small affinity for oxygen.[1, 2] Their blood cedes its oxygen readily to the tissues, permitting of an active life, but in water deficient in oxygen these fishes suffer. Carp, on the contrary, lead a sluggish life. Their hæmoglobin parts reluctantly with its oxygen, but it can capture the gas from poorly aerated waters and so enable the fish to survive. Trout, in effect, consume more oxygen than carp.[3, 4] The squid and the king crab offer a like contrast of blood with hæmocyanins.[5] Again, the oxygen affinity of respiratory pigments varies with temperature, and this circumstance may limit poikilothermal animals to different latitudes.[6]

Some marine invertebrates can live in brack[illegible] water, and it has been shown that these ani[illegible] sume more oxygen in the fresher wat[illegible]

sea.[7, 8, 9] This suggests that freshwater animals may necessarily have a higher metabolic rate than their marine relatives. Data, however, are lacking on this score. We have therefore compared the oxygen consumption of marine and freshwater amphipods and isopods. To obtain significant data, nearly related anæsthetised animals of the same size and sex were used. We have found that the metabolic rate of the freshwater species *Gammarus pulex* is 1½ times that of the marine *G. locusta* and *G. marinus*; and the metabolic rate of the freshwater *Asellus aquaticus* is 3 times that of the marine *Idotea neglecta*.

There is an equal absence of physiological data concerning freshwater animals limited in their distribution to swift streams and to still waters. Comparing the oxygen consumption of the larva of the mayfly *Bœtis rhodani*, an animal living in rapid streams, with that of its pond relative *Chlœon dipterum*, we find that the former has a value 3·4 times the latter. Moreover, the rates of their heart beats are as 3 : 1. Again, the metabolic rate of the caddis worm *Hydropsyche* sp., from rapid streams, is 1½ times that of *Molanna* sp., from ponds. Finally, an unexpected difference in oxygen consumption was found between members of one and the same species from two such habitats. The ratio of the metabolic rate of *Asellus aquaticus* from a swift stream to that of members of this species from slow water is as 3 : 2. It is hoped that breeding experiments will decide whether the last-mentioned difference is inherited or not.

H. MUNRO FOX.
B. G. SIMMONDS.

Zoological Department,
University of Birmingham,
July 16.

[1] Krogh and Leitch, *J. Physiol.*, **52**, 288; 1919.
[2] Root, *Biol. Bull.*, **61**, 427; 1931.
[3] Gardner and Leatham, *Biochem. J.*, **8**, 374; 1914.
[4] Gardner, King and Powers, *Biochem. J.*, **16**, 523; 1922.
[5] Redfield, Coolidge and Hurd, *J. Biol. Chem.*, **69**, 475; 1926.
[6] Fox, NATURE, **130**, 92, July 16, 1932.
[7] Schlieper, *Biol. Rev.*, **5**, 309; 1930.
[8] Beadle, *J. Exp. Biol.*, **8**, 211; 1931.
[9] Raffy and Fontaine, *C.R. Soc. Biol.*, **104**, 466.

Nitrogen Requirements of the Lactic Acid Bacteria

IN view of the importance attached by Orla-Jensen to the nitrogen source employed in the study of the lactic acid bacteria—an importance emphasised by the results of our own studies—we have investigated the nitrogen distribution in some thirty-seven sources of nitrogen, and have determined the influence of these sources on the production of acid from glucose, mannose, and lactose by five strains of lactic acid streptococci after fourteen days' incubation at 23° C. For the nitrogen distribution determinations we used the method of Wasteneys and Borsook. In the subsequent preparation of the sugar broths for the fermentation work and in the recording of the results we proceeded after the manner of Orla-Jensen. Certain of the nitrogen sources investigated are available commercially; many, principally peptic, digests of casein and some tryptic digests of casein, are such as may readily be prepared by laboratory workers.

Each of the streptococcus strains studied produces an amount of acid comparable with that produced by certain strains of *Sc. cremoris* when a peptic digest of casein, 1 per cent total nitrogen content, is used as the nitrogen source; the broth thus prepared containing 57·69, 20·36, and 17·39 per cent of proteose N, peptone N and sub-peptone N respectively. If the total N, content be 0·5 per cent, the total ...able acidity is not more in each case than from ... to one-third the amount already cited. A ... digest containing 1 per cent total nitrogen proves to be quite unsuitable as a nitrogen source for each of the organisms under study. When the total nitrogen content is 0·5 per cent, however, two strains are still feeble in the production of acid, but three strains produce from 6·0 to 8·6 grams acid (calculated as lactic acid) per mille. The tryptic casein digest broth contains 0·0, 27·68, and 69·82 per cent proteose N, peptone N, and sub-peptone N respectively. A commercial 'hydrolysed casein' broth prepared to contain 1 per cent total N shows an analysis of 35·84 per cent proteose N, 27·26 per cent peptone N, and 32·08 per cent of sub-peptone N. As a source of nitrogen this broth is very suitable for each of the five organisms, and particularly suitable for the three strains that, as described above, respond to a tryptic casein digest. Our results indicate that in fermentation studies on the lactic acid streptococci both the 'kind' and the 'amount' of nitrogen employed are critical.

This study is one of a series on cheese-ripening provided for by a research fund established jointly by the University of British Columbia and the Empire Marketing Board. A complete and detailed account of the work is in press awaiting the next issue of the *Journal of Dairy Research*, Cambridge.

BLYTHE A. EAGLES.
WILFRID SADLER.

University of British Columbia,
Vancouver, Canada, July 13.

The So-called Marsupial Bone in a Microchiropteran

THE epipubic bone in Marsupialia is a diagnostic feature of the group, but it has not hitherto been recorded in other Mammalia except, of course, in the Monotremata. Recently I have collected *Rhinopoma*

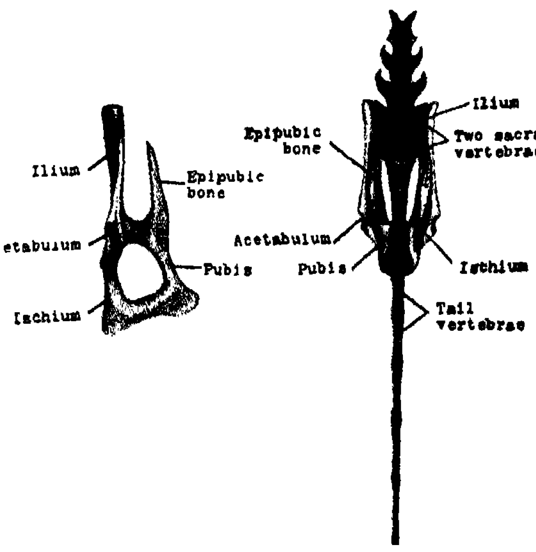


FIG. 1.—Pelvic girdle of *Rhinopoma microphyllum*. On the left, side view, × 2; on the right, ventral aspect, × ½.

microphyllum, a small bat, from Agra Fort near the famous Taj, during the last departmental annual excursion. This bat possesses an epipubic bone which looks exactly like that of the kangaroo (Fig. 1). The whole skeletal system in *Rhinopoma microphyllum* is very peculiar and will be discussed elsewhere.

HIMADRI KUMAR MOOKERJEE.

University College of Science and Technology,
35 Ballygunge Circular Road, Calcutta,
June 9.

Occurrence of the Cyclopoid, *Herrmannella rostrata* Canu, in *Cardium edule*

WHILST examining *Cardium edule* isolated in bowls and obtained from Morecambe Bay, Lancashire, Prof. Orton found an abundance of copepods and gave them to me for examination.

The copepod proved to be *Herrmannella rostrata* Canu,[1] one of the Lichomolgidæ leading a semi-parasitic existence in the cockle. When the cockles were opened separately in finger-bowls in the laboratory many of the copepods were clearly seen to leave their hosts; they appeared to be distributed throughout the mantle cavity but showed a tendency to congregate round the siphons. Tow-nettings from gulleys on the cockle beds in Morecambe Bay revealed a number of *Herrmannella* swimming actively in the sea-water amongst various Calanoids and other planktonic material. Males and females with and without egg sacs were seen both in the cockle and swimming freely.

Canu records *Herrmannella rostrata* from the mantle cavities of *Cardium edule* L., *Mactra stultorum* L., and *Pecten opercularis* L., from the French coast, but there does not appear to be any record of its being found in British waters. As it is so very abundant in *Cardium* from Morecambe Bay, it seems unlikely that it is of merely local occurrence, but possibly has been mistaken for *Lichomolgus agilis* (Leydig), a species which it closely resembles and which has been recorded from *Cardium* from many localities and from Lancashire by Thompson.[2] Sars, Canu, and many other writers[3] record *L. agilis* only from the Nudibranchiata.

J. H. FRASER.

Dept. of Oceanography,
University of Liverpool, July 9.

[1] Canu, E., "Les Copépods marins du Boulonnais", *Bulletin Scientifique de la France et de la Belgique*, Tome xxiii., 1891.
[2] Thompson, I. C., "Revised Report on the Copepoda of Liverpool Bay", *Trans. Liverpool Biological Soc.*, vol. vii., 1893.
[3] Canu, E., "Copépods du Boulonnais", *Travaux du Laboratoire de Zoologie Maritime de Wimereux-Ambleteuse*, Tome vi., Lille, 1892.

Habits of the Toad, *Ceratophrys*

A MISHAP which throws additional light on the voracious habits of the South American toad *Ceratophrys* deserves to be put on record. Four of these creatures were received here at the end of June and at the same time two small alligators. When they came, only one vivarium was ready for use, and for a week the toads and alligators shared accommodation in it. They appeared to ignore one another and to be perfectly content. The alligators spent much of the time basking on the top of a small wooden penthouse or immersed in the water trough: the toads dug themselves comfortable burrows and were soon effectively concealed. Both took the food that was offered to them, the toads showing an appetite for the common frog and the alligators for a diet of beef and worms.

Meanwhile a new vivarium was prepared. But when the day came to transfer the alligators to it, it was found that one of them had completely vanished during the previous night. A thorough search revealed no trace of the missing animal, and the suspicion grew that one of the toads was responsible for its disappearance. On the pampas they are reputed to steal chickens, and Gadow reports an instance of cannibalism even, on the part of one of a pair sent to him by a friend (cf. Cambridge Natural History—"Amphibia and Reptiles", p. 217). The four toads in this case were subjected to a screening examination with X-rays, and in one of them a large dark shadow distinctly disclosed the presence of the missing alligator. The length of the alligator was 11 in. over all (head 2 in., body 3 in., tail 6 in.). Its maximum breadth was 1¼ in. The corresponding dimensions of the toad are: length 6 in., maximum breadth 3½ in.

It remains to be said that the toad is digesting its unusual meal with the utmost complacency.

C. W. PARSONS.

Zoology Department,
University of Glasgow.

The Andean Eruption and Sunset and Sunrise Glows in South Africa

THE first sunset glow due to volcanic dust from the Andean eruption was seen in Cape Town on April 21. The glow, which was of remarkable intensity, started about fifteen minutes after sunset and lasted fully an hour, the colour being a deep fiery red. There were many inquiries that evening at the *Cape Times* office and at the Central Fire Station whether a large fire was raging in the suburbs; there were also numerous telephonic inquiries at the Royal Observatory as to the cause of the phenomenon. I therefore gave a statement to the *Cape Times*, which appeared in the following morning's paper, attributing the phenomenon to volcanic dust from the Andean eruption, and anticipating that it would be followed by sunrise and sunset glows for several weeks.

The glows have continued to be visible in Cape Town up to the present time, eight weeks since the appearance of the first glow, with varying but on the whole decreasing intensity. None, however, has been so striking as the sunset glow on the evening of April 21 and the sunrise glow the following morning.

I have collected some information as to the region over which the glows have been visible. It appears that they have been generally observed throughout the Union of South Africa and the Bechuanaland and Basutoland Protectorates. The effects appear to have been even more striking in the clear air of the Karroo and the high veldt than here. At Mafeking, one month after the appearance of the first glow, a trustworthy observer stated that the glow was of a fire-red colour stretching right across the sky, even long after darkness.

The speed of the easterly moving current of air which carried the volcanic dust across from South America would appear to be about twelve miles per hour.

H. SPENCER JONES
(H.M. Astronomer).

Royal Observatory,
Cape of Good Hope, July 14.

Aurignacian Flint Implements from Raised-Beaches underlying the Brown Boulder Clay

RECENTLY, in conjunction with Mr. J. Reid Moir, I recorded my discovery within the Thames valley of a Middle Mousterian occupation-floor overlain by gravel and brickearth (70 ft. above O.D.) and post-dating the formation of the Coombe Rock.[1]

I have since been engaged in a series of excavations in the estuarine gravels at Kirmington (90 ft. above O.D.) and to the west of Barton-on-Humber, Lincolnshire (50 ft. above O.D.). At both these sites the Brown Boulder Clay caps the estuarine gravel.

In addition to derived artefacts belonging to earlier periods, these estuarine gravels contain implements of Aurignacian age likewise exhibiting a rolled condition.

These specimens will be described before the Society of Antiquaries of London in November next.

J. P. T. BURCHELL.

30 Southwick Street,
Hyde Park, W.2.

[1] NATURE, 130, 95, July 16, 1932.

Research Items

Fossil Man of Asselar (Sahara).—A study of a fossilised human skeleton, discovered at Asselar, Cercle de Kidal, French Sudan, in 1927, has been published by MM. Marcellin Boule and Henri Vallois (*Mém. 9, Arch. Inst. Paléontologie humaine*). The palæontological and geological data of the discovery, though the latter are to some extent a matter of inference, warrant an Upper Pleistocene dating (Europ. Âge du Renne), and point with certainty to a period when the Sahara was well watered. No implements were found associated with the skeletal remains, but surface finds of upper palæolithic, mesolithic, and neolithic types, obviously later in date, were made not far away. The skeletal remains were neither water-borne nor buried, and appear contemporary with the fauna, now extinct in the area, found in identical deposits nearby. The skull, including the face, is well preserved. The principal parts of the skeleton which are missing are about two-thirds of the femora and tibiæ. It is probably the skeleton of a male of at least forty and possibly more than fifty years of age. The most striking characteristics are the dolichocephaly of the skull, the broad and dysharmonic face, platyrhiny, the size of the teeth, and primitive features in the jaw. The cephalic index is 70·9. The skull is high and the cranial capacity approximately 1520 c.c. There is distinct sub-nasal prognathism, though this character is not specially marked when the face is taken as a whole. When compared with other types of early and recent man in Africa, Asselar man is seen to resemble most closely types found in South Africa, especially the Hottentot and Bantu, more particularly in the features in which these can be regarded as unspecialised and primitive. It is suggested, therefore, that Asselar man and Grimaldi man are derivatives, perhaps to be associated with the Capsian industry, from an earlier less specialised type, which divided, one branch going north and evolving in the direction of Cro-Magnon man, while the other, going south, became the ancestral type of the Bushmen and the less specialised Hottentot.

The Royal Tombs, Monte Alban, Southern Mexico.—An interesting article by Mr. Herbert J. Spinden on the recent discovery of a treasure of gold in one of the tombs opened by Dr. Alfonso Caso on Monte Alban, Southern Mexico (*Brooklyn Mus. Quart.*, vol. 19, No. 2), stresses the cultural evidence of the finds as of more importance than their intrinsic value. For example, they bear out the derivation of metal, gold and copper, and the methods of working metal among the ancient inhabitants of Mexico from Colombia and Costa Rica. One of the interesting facts which emerge from the Monte Alban finds of gold ornaments is that the paddle-shaped feet-of-frog amulets from Costa Rica contribute to the shape of elaborate Mexican amulets dealing with very different subjects, such as a remarkable piece with dates on the flanged base. Mr. Spinden is unable to follow Dr. Caso in his attribution of these tombs to Mixtec temporarily in occupation of Monte Alban. He himself is of the opinion that they are Zapotec and that the site is the ancient Zaachila, famed as the capital of the Zapotecs, and called Teozapotlan by the Mexicans. This opinion is based very largely on the character of the architecture of the tombs, which are regarded as comparable to others which have been excavated on Zapotecan sites at Xoxa and Cuilapa; but the engraved human ...es found in heaps in the treasure tomb are certainly ...s to Mixtec work, and are probably connected ... cults of the Jaguars and Eagles. As it is clear, Mr. Spinden thinks, that ...eramics fall before the last pre-Spanish period, and after, rather than before, Toltec times.

Damage by Deer and its Control.—In Scotland, damage to crops by deer is a desultory and not very extensive occurrence, but in California the last decade has seen the problem gradually gaining in economic importance, until the State departments concerned have been compelled to take up the matter of control. One line of investigation prosecuted by Gordon H. True promises good results where damage is extensive, that of determining the efficiency of repellants (*California Fish and Game*, p. 156, 1932). The repellants tested consisted of various chemical substances playing upon the senses of smell or taste, and physical devices intended to play upon the natural wariness of the deer. It may be said at once that the latter, of the scarecrow or automatic flash gun type, soon lost any scaring effect they may have possessed at first. But the dusting or spraying of various chemical substances produced good results. For example, the spraying of blood upon orchard trees afforded 50-100 per cent protection. Other materials used were the proprietary *D4*, a mixture of whale-oil soap and liquor cresolis, naphthalene flakes, asafœtida, and each of these proved effective to some degree, although creosote and creosote dips met with little success. It was found, however, that the effectiveness of any repellant depended upon a number of conditions, such as temperature, rainfall, intensity of deer population, and the situation of crops to be protected with reference to wild country. So that a substance successful in one case may prove a failure in another. But the author is of opinion that where deer are causing extensive losses, the saving brought about by the use of repellants will more than counterbalance the cost.

Hybrid between Wolf and Dingo.—From a correspondent we learn that pairing between a male European wolf and a female Australian dingo in the Adelaide Zoological Garden resulted in a litter of six hybrid pups, all female. The hybrids more resemble the dingo than the wolf, and one has been sent to Melbourne Zoological Gardens for further experiments in hybridisation. Although it is stated that the cross is a rare one, if indeed it is not unique, the fact that dingos breed freely with the domesticated dogs of the settlers makes it not unlikely.

Madras Medusæ.—Mr. M. G. K. Menon, in a paper, "The Hydromedusæ of Madras" (*Bull. Madras Gov. Mus.*, New Series—Nat. Hist. Sec., vol. 3, No. 2, 1932), investigates the species from the surface layers of the shallow waters off Madras within three miles of the coast, the collections being made every other day, early in the morning, for a year. Out of 35 species obtained, belonging to 28 genera, 6 are new and there is one new genus. Most of the medusæ recorded are littoral, and there is every reason to think they were generated on the coast. After a general dearth of organisms in the sea in the late summer, roughly corresponding to the hottest time of year, an outburst of planktonic growth takes place and the hydromedusæ begin to appear, steadily increasing until January, in which month the maximum is recorded. After March there is a steady decline in numbers and, with few exceptions, a scarcity of species. The present collection adds considerably to our knowledge of the medusæ of the Indo-Pacific, and it is interesting to find such typical Atlantic species represented as, for example, *Amphinema dinema* and (probably) *Leuckartiara octona*. The author notices that in the canal system of some examples of *Æquorea parva* a number of radial canals have lost their connexion with the stomach and

have developed on their ventral surfaces openings surrounded by minute lips which are capable of functioning as accessory mouths. This is in agreement with *Mesonema pensile*, in which Browne observed that the canal system had taken on the function of the stomach, in this species the lower wall of the stomach being quite rudimentary. Browne has suggested that this may apply to other Æquoridæ and account for the large number of radial canals and excretory pores on the circular canal.

Crystalline Style in Large Molluscs.—The crystalline style which occurs in all bivalves and in many herbivorous gastropods is usually a gelatinous rod continually being secreted in a style sac and pushed forward so that its free end is in the stomach, where it is dissolved and sets free a powerful amylase and an oxidase. Dr. C. M. Yonge (*Proc. Malac. Soc.*, **20**, pt. 1, pp. 44, 45, March 1932) has examined the largest living bivalve, the giant clam, *Tridacna derasa*, on the outer reef of the Great Barrier Reef of Australia, and found that the style was 34 cm. in length and 0·5 cm. in breadth. The style had to be preserved in strong alcohol for two days before there was opportunity to weigh it accurately, and its weight was no doubt substantially reduced by this dehydration; its weight was then 3 gm. The length of the *Tridacna* from which it was obtained was 3 feet. At Bermuda, Dr. Yonge examined *Strombus gigas*, the largest of the herbivorous gastropods, which feeds on fine filamentous algæ, and found that in specimens 11½ in. and 10 in. long the respective styles were 22·25 cm. and 20·6 cm. long and 0·6 cm. broad, and weighed 2·8 gm. and 2·5 gm.

A Braconid Parasite of the European Corn Borer.—*Technical Bulletin* No. 294 (May 1932) of the U.S. Department of Agriculture is entitled "The Biology and Morphology of the Braconid *Chelonus annulipes* Wesm., a Parasite of the European Corn Borer", by Mr. Arlo M. Vance. The genus *Chelonus* includes a large number of species, many of which occur in Britain, but little detailed study of any of its members has been undertaken. The species in question parasitises the European corn borer (*Pyrausta nubilalis*) in Italy, and the present investigation has been made in connexion with its introduction into the United States, where the corn borer is well known as an immigrant pest of first importance. Mr. Vance gives a very thorough account of the external and internal structure of the *Chelonus* larva. The most notable feature seems to be the absence of Malpighian tubes, usually present in hymenopterous parasites. Small outgrowths, or buds, originating from the hind intestine, are considered to be rudiments of these organs. The process of excretion appears to be performed by special urate cells found in the fat body. The female *Chelonus* deposits an egg in that of the corn borer, and the larva passes through three instars within the growing larva of the host. At its last stage the parasite larva leaves its host and, after devouring the remaining tissues of the latter, spins a cocoon and pupates. At a constant temperature of 77° F. two days are required for the incubation of the parasite egg, about 20 days are occupied in larval development, and 9½ days are passed as a pupa. The period from egg to adult is estimated to require about forty days in the field.

Sclerotial Diseases of Rice.—Messrs. Malcolm Park and L. S. Bertus are working at the Royal Botanic Gardens, Peradeniya, Ceylon, upon the sclerotial diseases of rice (*Ann. Roy. Bot. Gardens*, **11**, pt. 4, pp. 319-332 and pp. 343-359; 1932). *Rhizoctonia* (*Corticium*) *Solani* not only gives trouble in the potato fields of England, but also causes a disease of rice in Ceylon. The symptoms of the malady are described in the first paper, and the characteristics of the fungus in pure culture are noted. Practical aspects of control have been considered, but, owing to the longevity of sclerotia in soil, the ordinary methods of crop rotation are inadequate. Experiments are to be directed towards finding a specific soil treatment. The other disease investigated is caused by *Sclerotium Oryzæ*, and has been studied with as much detail as the *Rhizoctonia* malady. It is possible to grow varieties of rice which are resistant, but irrigation water should never be allowed to flow through a diseased field, since it might carry infection. The disease occurs in patches in the rice-growing areas, and the crop growing on the patches should be burned at harvest time.

Gas without Oil.—The phenomenon of extensive accumulation of natural gas without associated petroleum is not by any means new, especially in certain parts of the United States and Canada. A somewhat unusual example is furnished by the Jackson Field, Mississippi, where a daily open flow of gas totalling 1,250,000,000 cubic feet from 42 wells has been estimated. The actual amount drawn from the field last year was about 13,000,000 cubic feet a day, a comparatively small proportion of available supplies. This gas has a high calorific value and contains a large percentage of methane—in one case 64·45 per cent, in another case 90·23 per cent; other constituents are ethane, carbon dioxide, and nitrogen, the latter in sufficient quantity to suggest a possibility of helium content, though the report of this area by Mr. Watson H. Monroe (*U.S. Geol. Sur.*, Bull. 831-A, 1931) makes no specific mention of this.

Coal of the Northumberland Area.—The Department for Scientific and Industrial Research has issued Paper No. 22 of the Physical and Chemical Survey of National Coal Resources, dealing with the 'Main Seam' of the Northumberland Area (London: H.M.S.O. 1*s*. 6*d*.). The report contains detailed analyses of samples taken from 16 points over the whole area, which is an important one, producing 50,000,000 tons annually and largely for export. The coal is frequently of high quality, but varies in caking properties. The association of a high sulphur content where the caking properties are good has prevented the development of a Northumberland coking industry. The coals are marketed primarily for home and steam purposes.

International Colorimetry.—The discussions which have been going on for some time in Great Britain and other countries as to the best method of measuring and specifying colour have for the present been settled by the decisions of the International Illumination Congress which met in September last at Cambridge. A report and discussion of these decisions by Mr. T. Smith, who was chairman of the Committee on Colorimetry, and Mr. J. Guild appear in part 3 of vol. 33 of the *Transactions of the Optical Society*. The trichromatic specification of colours is to be adopted as the standard one, but the three primary colours are to be such that the amounts of each necessary to match a colour occurring in practice shall always be positive. This involves a departure from the system of primaries adopted previously by the National Physical Laboratory, the R, G, and B of which were the spectral lines 7000, 5461, and 4358 respectively, and the equations specifying R, G, and B and the standard white light in terms of the international primaries are given. The standard white is that transmitted from a gas-filled incandescent lamp operating at a colour temperature of 2848° absolute through two blue solutions of specified compositions.

Optical Diffraction by Sound Waves.—Sup[illegible] waves in liquids have a space periodi[illegible] small to be comparable for diffract[illegible]

the wave-length of light, and if the density changes are sufficiently large, should be able to act as a grating. This effect, which was predicted by Brillouin, has now been observed by P. Debye and F. W. Sears (*Proc. U.S. Nat. Acad. Sci.*, June 15) and made the basis of a method for finding the speed of supersonic waves, the wave-length being found by the optical experiment in terms of the wave-length of light, and the frequency by a radio wave-meter. The theory is not given in full, but leads to the ordinary diffraction formulæ, so far as the angular deviation of the light is concerned. The diffraction pattern in its higher orders provides a test of the constancy of the speed of the supersonic waves. By measuring the intensity of the diffracted beams when the light is passed through the liquid at different distances from the source of the waves their attenuation can be calculated, but so far has been found to be appreciable only for glycerine, which probably acts in this way from its high viscosity.

Optical Absorption of Solutions of Sulphur.—An example of the value of a study of optical absorption spectra for obtaining information concerning the molecular condition of a dissolved substance is given by Prof. Campetti in a paper published in parts 6-10 of the *Rendiconti* of the Reale Istituto Lombardo di Scienze e Lettere for 1932 (vol. 65). Results are given of determinations of the absorption limits for solutions of sulphur in *m*-xylene and carbon tetrachloride at temperatures ranging from 20° to 130°. The curves connecting the limits of absorption (ordinates) with the concentrations of sulphur in the two solutions at any one temperature intersect near the absorption axis. If, however, the initial ordinate is made the same for both curves, the curve for the carbon tetrachloride solutions lies wholly above that for the *m*-xylene solutions, so that a given weight of sulphur dissolved in the former solvent exerts a somewhat greater absorbing effect than when dissolved in *m*-xylene. Since the formation in solution of molecular groups of greater complexity than S_8 is improbable, the obvious and almost necessary explanation of such behaviour is that sulphur and *m*-xylene give rise to molecular associations with absorption less than the sum of those of the components separately. This conclusion appears to be related to the fact that, at temperatures which are not too high (about 195°), the two liquids—liquid sulphur and *m*-xylene—are miscible in all proportions.

Astronomical Topics

New Comet.—A comet of magnitude 7½, visible in an opera glass, was discovered independently by Mr. L. Peltier at Delphos, Ohio, and by Dr. Whipple photographically at Harvard. It is Mr. Peltier's third cometary discovery and Dr. Whipple's first, though his name is very well known as a cometary observer and computer. He and Mr. L. E. Cunningham have computed the following orbit for the comet:

$$\begin{array}{ll} T & 1932 \text{ Sept. } 1{\cdot}510 \text{ U.T.} \\ \omega & 38°\ 10' \\ \Omega & 344\ \ 40 \\ i & 71\ \ 49 \\ \log q & 0{\cdot}01662 \end{array} \left.\begin{array}{l} \\ \\ \\ \end{array}\right\} 1932{\cdot}0$$

The comet is in high northerly declination, and visible all night; an ephemeris is given for 0^h U.T.:

	R.A.	N. Decl.
Aug. 21	$4^h\ 7^m\ 20^s$	64° 51′
25	5 5 12	73 38
29	7 5 58	79 22
Sept. 2	9 57 36	79 47
6	11 44 44	76 22
10	12 35 45	72 12
14	13 3 14	68 16

The following observations have come to hand; the first is by Mr. Möller at Copenhagen, the others by Dr. W. H. Steavenson at Norwood:

U.T.	R.A. (1932·0).	N. Decl.
Aug. $10^d\ 23^h\ 7^m\ 18^s$	$3^h\ 11^m\ 35{\cdot}25^s$	38° 27′ 27·6″
11 23 42 24	3 14 54·41	41 8 11·2
12 23 21 15	3 18 25·16	43 45 15·8
13 23 39 5	3 22 22·52	46 27 35·7

Dr. Steavenson saw a short tail, the shape of which resembled that of Halley's comet in miniature; it made a considerable angle with the radius vector produced.

Observations of Radio Signals during the Eclipse.—A Science Service Bulletin, dated July 25, invites the co-operation of all who have means of estimating the strength of radio signals in observing the effect of the eclipse on these signals. In a letter in NATURE of May 21, p. 757, Profs. S. Chapman and E. V. Appleton pointed out that the radio effect may be expected to precede the optical eclipse by two hours, so that the British Isles come within the affected region; observations should be continued during the whole of [illegible] of Aug. 31, but it is in the latter part [illegible] effect is to be looked for. The main [illegible]ation is to test theories about the upper and lower Heaviside layers; one theory ascribes both layers to the action of ultra-violet light from the sun; the other theory ascribes the lower layer to neutral particles streaming from the sun. In the former case the effect would be limited to the regions of optical eclipse; but in the latter view the slower motion of the particles would cause an eastward shift of the radio eclipse compared with the optical one. Also the streams of particles are supposed not to come from the whole sun, but from special regions; this would make the region of radio eclipse as broad as the diameter of the moon, as contrasted with the hundred-mile width of the zone of optical totality.

Lunar Computations for the *Nautical Almanac*.—An article by Dr. L. J. Comrie (*Mon. Not. R.A.S.*, May) illustrates in a vivid manner the immense aids to astronomical calculations that have been afforded by mechanical inventions in the present century. Prof. Brown's Lunar Tables were introduced into the almanacs for 1923. More than 1400 periodic terms are tabulated, and the computations up to the present have involved the continuous work of two skilled computers. Dr. Comrie noticed that much of the work could be facilitated by the use of the Hollerith tabulating machine, and was instrumental in obtaining the hire of a machine for the office of the *Almanac*; by its aid it has been possible to carry out the larger part of the lunar computations for the remainder of the present century at an aggregate cost of less than a quarter of what it would have been on the old method, and with considerably greater security against error. The details of the process are described in the paper. The first stage is to divide the period of each harmonic term into an integral number of parts, so chosen that the motion in a day is an integral number of these parts; the next stage is the preparation of cards, which are punched with holes in different columns, the height of the hole in each column indicating the corresponding digit. The cards for each harmonic term are then arranged in stacks. The top cards of each stack, representing the first date, are collected by hand into another stack; the addition of harmonics is performed by the machine, and the result printed. An important feature is the sorter, which automatically arranges the cards in groups according to the numbers punched in any selected column. The result is easily checked, since all the cards in each stack have a hole in the same place, so that there is a tunnel right through the stack.

The University of Rangoon

By Prof. D. H. PEACOCK

IN July 1931, the University of Rangoon held its annual Convocation for the first time in the new Convocation Hall, the Training College opened its new buildings, and in November of the same year University College and Judson College moved into the science wings of their new buildings, of which the arts wings had already been in use for some time. The work of building the University of Rangoon is thus virtually complete.

The buildings in existence in 1920 were quite unsuited to the needs of a modern university, and while the constitution of the new University was under consideration, tentative projects for new buildings were drawn up. Sir Spencer Harcourt Butler, when Lieutenant-Governor of Burma, had wisely reserved a site of some four hundred acres about five miles from Rangoon on the southern shore of the Victoria Lake, and, in December 1922, Sir Reginald Craddock, Lieutenant-Governor of Burma, laid there the foundation stone of the new Convocation Hall. No provision had at this time been made for funds for the new buildings and no body had been authorised to carry out the work, but both matters received early attention from Sir Spencer Harcourt Butler, who returned to Burma as Governor in January 1923. In 1925 the Government of Burma constituted a Building Trust of fifteen members, of whom four were elected by the University, to carry out the erection of the University buildings with the exception of the Medical College. The full-time services of Mr. M. J. Sheehy were placed at the disposal of the Trust as executive engineer, and as occasion arose the Trust was also able to utilise the services of Colonel Longdin and Mr. C. C. Codrington for the water supply, sanitation, and mechanical ventilation and of Mr. Eades for the electrical installation. The first chairman of the Building Trust was Sir Robert Giles, and he was succeeded by Sir Oscar de Glanville, who has completed the work. The University is also greatly indebted to Sir Charles Innes, Governor of Burma since 1928 and Chancellor of the University, to whose sympathetic consideration is largely due the provision of the necessary funds, and to Sir Benjamin Heald, Vice-Chancellor of the University.

The Government of Burma set aside a sum not exceeding £780,000 for the buildings and their ancillary services. The Building Trust had not only to erect new buildings for the existing colleges—University and Judson—but also to build a Convocation Hall for the University, a Training College for Teachers, and houses for the staff and servants of the colleges and the University. In addition, much that is usually provided by local authorities had to be provided by the Building Trust; roads had all to be made, wells had to be sunk and a waterworks erected, and septic tanks and a complete system of sanitation had to be provided. It should be mentioned that the American Baptist Mission defrayed half the cost of the erection of Judson College.

FIG. 1.—University College, Rangoon.

The Convocation Hall, the buildings of University and Judson Colleges, and the Training College for Teachers are of steel-framed brick coated with white plaster. University College (Fig. 1) consists of six blocks of buildings joined by a colonnade running north and south. The College Library is one hundred and forty feet long and thirty feet wide, and behind it are the College Hall and students' common rooms. On either side of the library block are the north and south arts wings; each is a three-storied building approximately two hundred and fifty feet long and forty feet wide. At the back of the College are the three science wings, which are of the same height and exterior appearance as the arts wings. The north science wing contains the physics department and, on part of the top floor, the geology department. The middle wing is devoted to the chemistry department. The south wing contains the departments of forestry, botany, and zoology and the institute of helminthology. All the science wings are approximately two hundred and twenty feet long, the north and middle wings forty feet wide, and the south wing is thirty feet. Communication to rooms in all the te...

by a deep verandah on the south side. All windows and doors are steel-framed; the floors are for the most part parquet floors of Burmese teak. The verandah floors, however, and the floors of some of the laboratories are of salemite. The physics and chemistry laboratories deal with some four hundred students a week, the majority being pre-intermediate students. Post-graduate work is undertaken by very few students. The buildings of Judson College are similar in plan to those of University College but smaller.

The College buildings are separated by a short distance from their hostels. University College has eight men's hostels, each able to accommodate about one hundred and twenty students and managed by a warden, an assistant-warden, and tutors. Five of these hostels have a central dining-hall, while the other hostels have their own dining-halls. The hostel fees of men students, which include board and lodging, amount to about £2 a month. In addition to these hostels for men, there is a hostel for women students, which accommodates about one hundred and twenty students and is managed on similar lines to the men's hostels. Judson College has two men's hostels and one women's hostel, all similar in construction to those of University College. All except three of the hostels are built of red brick and were designed by Mr. S. P. Bush, Government architect, Burma. The hostels of all the colleges can together accommodate about 1300 men students and about 300 women students. Both Colleges have large playing fields.

The University Convocation Hall is situated near the lake front at the north end of the estate, with the main buildings of University and Judson Colleges to east and west of it. It can hold some two thousand people and is one of the most striking buildings in Rangoon. It is a steel-framed brick building coated with cement plaster, and has a parquet flooring of Burmese padauk and is panelled with yinma, one of the most beautiful of the lighter-coloured Burmese hardwoods. The main doors are of bronze and open on to marble steps covered by a bronze marquise. The Convocation Hall, the main buildings of University and Judson Colleges, the University Library, and three of the University College hostels were designed by Mr. T. O. Foster.

The University Library was the gift of a generous donor who did much for the cause of education in Burma, Raja Dr. Reddiar, and has been built at a cost of some £15,000. The bookstack is to be fitted with an air-drying plant which will be, so far as is known, the first of its kind to be used in any library. The colleges already possess quite well-stocked general libraries, and the University Library is being devoted mainly to Oriental studies, including language, history, and art. In this connexion, University College has established a lectureship in Far Eastern history, and a considerable amount of work is being done in the University on the history of Burma.

The University Students' Union building and the University gymnasium, both designed by Mr. T. O. Foster, were the gifts respectively of Dr. Tun Nyo and Mr. Ch... Chor Khine. Both buildings are well equipped for the purposes for which they are used.

The Teachers' Training College, designed by Mr. Armstrong, is situated in the southern part of the estate, and in addition to administrative and teaching buildings and hostels for men and women students, contains two practising schools, one for boys and one for girls, each with hostel accommodation for resident pupils. Provision has also been made for training in kindergarten work, and it is hoped that the College will supply what is the most urgent educational need in Burma, namely, well-trained teachers for the schools. The normal schools did excellent work in the face of great difficulties, but they lacked the resources now at the disposal of the Training College.

The engineering department of University College is housed in a set of buildings some half-mile distant from the main College buildings. For their erection a most munificent donation of £100,000 was made by the Burma Oil Company, and part of this donation has been used as an endowment towards the necessarily heavy expenses of upkeep.

Housing accommodation for the staffs of the constituent colleges and of the University has been provided by the Building Trust, which also has built a sanatorium for the students, a book-shop, a post office, a village for the servants of the colleges and the University, and quarters for the staff of the University training corps.

The Late Palæolithic Inhabitants of Palestine *

THE skeletal material of late palæolithic age from Palestine, upon which Sir Arthur Keith reported to the International Congress of Prehistoric and Protohistoric Sciences at a meeting held on Aug. 3, was collected by Miss Dorothy Garrod from deposits in caves at Shukbah in the Judæan Hills in 1928, and on Mount Carmel in 1929, 1930, and 1931. For the industry with which the remains were associated, a new mesolithic industry, Miss Garrod proposes the name 'Natufian', after one of the sites on which it was found. An account of this industry was communicated to the Congress by Miss Garrod at a subsequent meeting held on Aug. 5.

Sir Arthur proposes that the people represented by these remains should also be known by the name of 'Natufian'; for, in his opinion, they were a peculiar people, not to be identified with any living race. They have affinities with the neolithic people of Malta, with the negroid element represented among European peoples in the Aurignacian period, and, more distantly, with the predynastic inhabitants of Egypt and the late palæolithic people of North Africa. Among living peoples they approach most nearly to the Mediterranean race.

At Shukbah, remains of 45 individuals were found—25 adults (9 males and 16 females), 17 children, and 3 adults of indeterminate sex. At Mount Carmel, on the terrace in front of the cave, was a veritable cemetery: 87 individuals were represented—35 adult males, 23 adult females, 23 children, and 6 indeterminate. The proportion of the remains representing a complete skull or skeleton is small. Only 20 individuals afford skull size and shape, and in many cases allowances have to be made for distortion due to pressure.

There are, however, several features which stand out definitely. They were a dolichocephalic people with a cephalic index varying from 72 to 78; they had cap-shaped occiputs; the dimensions of the head are greater than in the predynastic Egyptians. They were prognathous, the sub-nasal prognathism being marked. The nasal bones formed a wide low arch; and the chins were not prominent. Many had big heads.

The stature was low, few men exceeding 1·650 m. (5 ft. 5 in.), most being about 1·600 m.; the women were about 1·524 m. (5 ft.). A striking character is the strong development of the bones of thigh and leg

* ...stance of a paper read before the First International Congress ...and Protohistoric Sciences, London, Aug. 1–6, by Sir ...
...1930]

in contrast to those of the arm, forearm, and shoulder. The thigh bones have a prominent linea aspera, the tibiæ are platycnemic. In more than half the humeri there is a perforation of the olecranon fossa.

Some interesting observations were made on the cultural practices of the Natufians, for which evidence was afforded by the skeletal remains. The two upper incisors of the women were extracted in youth. Evidence for the same practice was found by Mr. Turville-Petre at Kebara, between Shukbah and Carmel. The Natufians also seem to have practised cannibalism. The bones are cut and fractured, the cut and broken surfaces showing that this was done when the bones were in a fresh state. This was at Shukbah only. No evidence of mutilation of the dead was found at Carmel or Kebara.

Evidence of a curious practice was found at Kebara. In the mesolithic deposits were found an assortment of bones which had been burned—not when fresh, but after they had been freed from animal matter by burial or exposure. The bones thus treated, which were collected by Mr. Turville-Petre, represent at least 75 individuals, mostly women. A similar collection had been forwarded to Sir Arthur by Mr. Leonard Woolley, which had been obtained from under the foundations of Ur. Here, too, women's bones preponderated. Further, Miss Caton-Thompson had obtained two skulls (female) from Zimbabwe which had been burned after the flesh had disappeared from the bones. Is this evidence, asks Sir Arthur, of a custom in ancient times of digging up the bones of ancestors and submitting them to the ordeal of fire?

Recent Archæological Field Work in England

THOSE members of the International Congress of Prehistoric and Protohistoric Sciences who elected to join the excursions arranged for the week (Aug. 6–13) immediately following the meeting in London, were fortunate not only in being afforded an opportunity to visit a number of important sites, but also in having demonstrated to them the latest results of this season's work by those who are in charge where excavation is now proceeding.

After dividing into two parties, of which one made its headquarters at Cambridge and the other at Oxford, they rejoined at Salisbury. The Oxford party on the way to Salisbury visited Winchester and Easton Down, near Salisbury. At the latter, they were shown the flint mines discovered from the air by Dr. J. F. S. Stone two years ago, and since excavated by him. The site covers 100 acres, and has a system of V-shaped ditches with deep pits at their convergence, similar to those of Grimes Graves, and containing quantities of half-manufactured implements, antler-picks and shoulder-blade shovels. Within the last few weeks, Dr. Stone has discovered a fresh pit of two courses, each eight feet in depth, with a shallower work nearby, which indicate how the neolithic miner worked.

Among the sites visited from Salisbury by the members of the Congress were the Iron Age fortress on Yarnbury Plateau and the Early Bronze Age site at Windmill Hill, which is being excavated by Mr. Alexander Keiller. At Yarnbury the triple line of fortifications surrounds the largest prehistoric stronghold in Wiltshire. It is 28½ acres in extent, with ramparts 25 ft. high. Within the triple rampart is a single rampart, or rather its remains, and a ditch. Some surprising results achieved in the excavations of the past two months were described by Mrs. M. E. Cunnington. The inner fortifications are not neolithic, as has been thought, but Iron Age work of a period slightly anterior to the triple line. The area was strewn with Romano-British pottery. A cutting in the interior rampart has revealed the post-holes for a chalk revetment sustained against a wooden wall. In the causeway, the only entrance to the fortress, has been found the most impressive Iron Age ditch so far discovered, a V-shaped excavation 12 ft. deep, so acute in angle that it would be impossible for two ranks of attackers to stand on the bottom. In the past few weeks there have also been discovered the guard-house and store-house of the fortress, while above the site of the ditch was the skeleton of a man wearing leather boots with hob-nails and bronze decorative studs.

At Windmill Hill, Mr. Keiller described the results of recent work, which now centres upon the excavation of the outer ditch, some 20 ft. wide and 8-9 ft. deep. Mr. Keiller announced that one-third of the site, which is the largest so far to be observed as included in this type of Early Bronze Age camp, is to be placed in trust for a century so that its excavation may be delayed until the results can be interpreted in the light of the fuller information which will then be available for archæologists.

Submarine Gravity Survey in the Bahamas

AN interesting piece of geophysical investigation has just been completed by an expedition carried out jointly by the United States Navy and the Department of Geology, Princeton University, with the co-operation of the United States Coast and Geodetic Survey. The introduction, in 1923, by Dr. Vening Meinesz of the Dutch Geodetic Commission, of a gravity pendulum apparatus capable of operating on a base not absolutely free from disturbing oscillation, led to the use of a submarine for the determination of the force of gravity over sea-beds and ocean-beds. During the next three years, three voyages in Dutch submarines were made by Dr. Vening Meinesz, and in the course of these he added much to the knowledge of the distribution of the force of gravity over the earth's surface.

In 1928 the United States showed an official appreciation of this pioneer work by inviting Dr. Vening Meinesz to bring his apparatus and carry out a similar investigation in United States waters with the help of a submarine of the U.S. Navy. The cruise was carried out in the autumn of 1928 and covered an area of considerable geological interest in the Caribbean Sea, the Gulf of Mexico, and to the north of Porto Rico. With the land pendulum stations established in that region by the United States Coast and Geodetic Survey, a considerable body of evidence was thus made available for the study of questions of isostatic equilibrium and of tectonic development.

It was a natural consequence that a desire should be expressed by geophysicists for the extension of the investigation to cover the whole of the British West Indies. The consent of the British Government for a submarine of the United States Navy to operate in these waters was obtained, and Dr. Vening Meinesz once more placed his special pendulum appar-

his own services at the disposal of the expedition. The moving spirit in this work, and the director of the expedition, was Prof. Richard M. Field, of Princeton University. He has, since 1922, made a special study of the stratigraphy and structural geology of the continental borders of the Atlantic Basin. In the course of this study he has led three expeditions to the Bahamas region. Dr. Bowie, chief of the Geodetic Division of the United States Coast and Geodetic Survey, was also an active supporter of the expedition. An observer, Lieut. J. P. Lushene, from his department, accompanied Prof. Field in the yacht *Miami*, owned and sailed by Lieut. Hugh Matheson, U.S. Naval Reserve, and made pendulum observations at a number of island stations in the region covered by the submarine party. The U.S. submarine *S.48* Lieut.-Commander O. R. Bennehoff, with Dr. Vening Meinesz on board, left Guantanamo, Cuba, on Feb. 7, 1932, being accompanied by the parent ship U.S.S. *Chewink*, Lieut.-Commander G. A. Miller. In the course of the next two months a cruise of some 4000 miles, in three loops, was made by these vessels, a large number of soundings by the sonic and by the supersonic apparatus were made, and the force of gravity was determined at 53 stations.

This notable expedition was given an international character by appointing advisory committees of prominent persons to deal with the subjects: navigation, geophysics, tectonics, oceanography, sedimentation, marine micro-biology. The Royal Society made a grant of £400 towards the sinking of a bore-hole on Andros Island, Bahamas. In the capable hands of Prof. Field, Dr. Vening Meinesz, and others, the results of the expedition are likely to yield valuable information, not only as to the history of the region, but also in the sphere of tectonics, or the theory of present-day processes in the more active regions in the earth's crust. Gravity survey at sea has come to stay as a major geophysical research, and it is, happily, likely to figure in the not distant future as an object of co-operation between the Navy and scientific authorities of Great Britain.

Calendar of Geographical Exploration

Aug. 21, 1721.—Easter Island

Jacob Roggeveen sailed from the Texel with three ships. On April 6, 1722, he discovered Easter Island, and described for the first time the remarkable stone figures found on that island. A buccaneer, Edward Davis, was reported to have sighted the island in the previous century, but there is no conclusive evidence that he did so. Several other islands were discovered, though it is difficult to identify them from Roggeveen's description: Raiotea in the Society Group was certainly one of them.

Aug. 23, 1683.—A Survey of the Galapagos Islands

A party of buccaneers, among whom were Dampier and Cowley, sailed for the South Seas. They sighted land which they charted as Pepys Island, but which was probably a headland of the Patagonian coast. They were joined by a second ship under Eaton and visited the Galapagos group, where they made a long stay; Eaton and Cowley drew the first fairly accurate chart of these islands, and Cowley's journal long remained the standard authority on them. The islands were discovered by the Spanish in the sixteenth century and received their name from the giant turtles which have evolved there. Charles Darwin found valuable data for his "Origin of Species" in the Galapagos, which he visited in the *Beagle*, a large pro[portion] of the fauna and flora being peculiar to the

Aug. 24, 1499.—Coast of Venezuela

Alonzo de Ojeda discovered the great inland Gulf of Maracaibo, which he called San Bartolomé. Ojeda sailed with four vessels from Cadiz in May 1499, reached Surinam, and coasted past the mouths of the Essequibo and the Orinoco. Rounding the peninsula of Paraguana, they entered a large gulf where they saw pile dwellings, hence they named the gulf and its coasts Venezuela (Little Venice). They passed through the strait to Maracaibo, and after sailing west to Cabo de la Vela, returned home.

Aug. 24, 1897.—Gerlache Strait

Adrien de Gerlache left Ostend in the *Belgica* on an antarctic expedition, Roald Amundsen being mate and Arçtowski accompanying it as geologist. Funds were raised mainly through the personal enthusiasm of Gerlache and his companions; the Brussels Geographical Society opened a subscription list and the Belgian Government gave a small grant. Soundings were made of the hitherto uncharted sea between Cape Horn and the South Shetlands. The strait named after Gerlache, between the Palmer Archipelago and the mainland, was discovered and Graham Land was followed to Alexander I. Land. Finally the vessel was frozen in for the winter in 71° 30′ S. For the first time, a party of scientific workers wintered in the antarctic night; the sun did not appear from May 15 until July 22. The party suffered severely and one died, but scientific observations were steadily continued. The *Belgica* brought back a wealth of data and specimens, and the Belgian Government published the results for which the expedition is justly famous.

Societies and Academies

DUBLIN

Royal Dublin Society, June 28.—**J. Joly**: A suggested mode of radiotherapy when long continued feeble gamma radiation may be desirable. Since all living beings are normally exposed to cosmic radiation, it is conceivable that a comparatively mild increase in the exposure to penetrating radiation might be beneficial in certain diseases. This may be effected by the application of a fabric coated with a radioactive paint prepared by mixing very finely powdered uraninite with acetone containing 10 per cent cellulose acetate. This paint adheres firmly to the surface of the fabric.—**E. J. Sheehy**: Effect of the conditions of storage on the vitamin D potency and on other features of cod liver oil. Storage in transparent bottles, or in tin-lined containers, or in partly filled barrels, does not materially reduce the vitamin D potency. Exposure to light bleaches the oil, whilst exposure to air deepens the colour and increases the rate of production of free fatty acid.—**William Hughes**: A study of *Phoma Lingham* (Tode) Tesm., and of the 'dry rot' it causes, particularly in swede turnips. A number of fungi occur on diseased plants which are considered forms of *Phoma Lingham*, but the one which is exclusively associated with typical dry rot of the roots in Ireland, and is predominant on other organs, is identical with the American cabbage black-leg organism and with Cunningham's Strain II.A from New Zealand. On plants other than swede and turnip, Strain II.B predominated. Strain II.A was the only one which consistently produced dry rot of swedes in the field and laboratory. Strains I.B and II.B (with one exception) failed to do so in the field, while producing a rot in the laboratory. Dry rot may originate from three sources, namely, (1) the seed, (2) from diseased roots of a previous crop which survive in the soil, (3) from similiar roots present in the farmyard manure.

Extensive field experiments, extending over a period of three years, show that infection present in the seed is not capable of producing outbreaks of dry rot so serious as those originating from contamination in soil or manure.

PARIS

Academy of Sciences, July 4 (vol. 195, pp. 1-84).—The president announced the death of Paul Vuillemin, *correspondant* for the Section of Botany, and of Bernhard Bang, *correspondant* for the Section of Rural Economy.—**Henri Lecomte**: Notice on Jean Paul Vuillemin.—**Charles Richet**: Organic memory (elementary memory, anaphylaxy, etc.).—**Charles Achard, Augustin Boutaric, and Fernand Morizot**: A method of studying sera according to their sensitising action in the flocculation of ferric hydroxide.—**C. de la Vallée Poussin**: The properties of harmonic functions in an open domain limited by surfaces with restricted curvature.—**Paul Pascal and André Dupire**: Contribution to the study of the esters of arsenious acid. The method adopted for removal of the water formed during the reaction between the alcohol and arsenious anhydride was the addition of benzene or toluene; the vapours after condensation were freed from water by anhydrous copper sulphate and the dry hydrocarbon returned to the reaction flask. Sixteen arsenites were thus prepared, of which the physical properties are given.—**P. Vincensini**: Certain families of surfaces.—**Georges Darmois**: The deformation of space in the theory of relativity.—**Georges Calugaréano**: The exceptional values (as defined by Picard and by Nevanlinna) of meromorph functions.—**D. Wolkowitsch**: The problem of a solid movable about a fixed point.—**Salmon-Legagneur and Bertrand-Lepaute**: The synchronisation of circular balance wheels of chronometers. A method for synchronising escapements with circular balance wheels by alternating current from the mains.—**Jacques Valensi**: The utilisation of ventilating fans with adjustable vanes for regulating the air velocity in an Eiffel blower.—**Henri Mineur**: The residual velocities of the stars and the problem of the temperature of the Milky Way.—**Jacques Winter**: Remarks on the integral equation of Bloch (electronic theory of metals).—**R. Anthouard**: The characters of the supply currents of a discharge in air under low pressure.—**V. Posejpal**: A general formula for absorption.—**R. Freymann**: The effect of dilution and of temperature on the infra-red absorption bands. Molecular associations. It has been previously shown that when an alcohol is diluted with a solvent the intensity of the band due to the OH group increases, passes through a maximum, then decreases. It is now found that this is not due to electrolytic dissociation, and the hypothesis of molecular association is discussed.—**Servigne**: The carrying down of polonium by crystalline oxalates in nitric acid solution. The oxalates of lanthanum, scandium, calcium, and strontium have been examined from this point of view. The results of the experiments are in favour of the view that polonium is trivalent in its oxalate.—**Berthon**: The displacement of some chemical equilibria based on the selective adsorption of the hydroxides by silica gel.—**Jean Cournot and Jean Challansonnet**: The primary graphitisation of cast irons containing molybdenum. It is possible to add up to 2 per cent of molybdenum to grey cast iron without the formation of free carbides. The castings remain grey in spite of rapid cooling after pouring.—**Ernest Kahane**: The estimation of arsenic in organic materials after destruction with perchloric acid. Full details are given of the method, which is based on the use of a mixture of nitric, sulphuric, and perchloric acids.—**L. Debucquet and L. Velluz**: Organic compounds with the sulphides of tellurium, arsenic, and tin. The compounds described are of the type $TeS_2 . C_4H_{10}N_2 . H_2S$.—**André Duparque**: The petrographic characters of coking coals.—**J. P. Arend**: The original mixture of oolithic Lorraine-Luxemburg minerals.—**Raymond Furon**: The schisto-calcareous series of the Sudan: its base conglomerate and its stratigraphical position with respect to earlier series.—**N. Arabu**: The existence of phenomena of overlapping in the gneiss zone of Sainte-Marie-aux-Mines (Alsace).—**Louis Dangeard and Pierre Bout**: Observations on the constitution of the Perrier mountain, near Issoire (Puy-de-Dôme).—**L. Clariond**: The Stephanian of Ida ou Zal (western Morocco).—**Edouard Roch**: The interpretation of the stratigraphical series of the region of Entifa and Beni Ayatt (central Morocco) and a hypothesis concerning other Moroccan regions.—**Louis Dubertret**: The structural forms of Syria and Palestine; their origin.—**Edouard Salles**: The value of the electrical field of the atmosphere at high altitudes. Reasons are given for supposing that the figures of Andrée (of the order of 12 volts) are much too low.—**R. Bureau**: The rôle of the phenomena of propagation in records of atmospherics.—**A. Piccard, E. Stahel, and P. Kipfer**: The intensity of the cosmic radiation at 16,000 metres altitude. At this height there is a large increase in the cosmic radiation as measured by an ionisation chamber and by the Geiger-Müller counter.—**Ph. Joyet-Lavergne**: Some characters of cytoplasmic sexualisation in Algæ and Fungi.—**Fr. Rutishauser**: The chemical composition of *Vinca minor*.—**Louis Gallien**: The evolution of the generation descended from the neotenic forms of *Polystomum integerrimum*.—**A. Dehorne**: The morphological value of the blood corpuscles of *Magelona papillicornis*.—**René Wurmser and Mlle. Nelicia Mayer**: The equilibrium between lactic and pyruvic acids.

COPENHAGEN

Royal Danish Academy of Science and Letters, Feb. 6.—**Ojvind Winge**: A new species, *Brassica napocampestris*, originated through species crossing and chromosome doubling. On crossing *Brassica napus*, with 18 chromosomes, and *B. campestris*, with 10 chromosomes (haploid), Mr. H. N. Frandsen, Taastrup, Denmark, succeeded in getting a new constant species with 28 chromosomes haploid. The new type owes its origin to a somatic doubling in the F_1 zygote, in accordance with the hypothesis of 'indirect chromosome binding' (Winge, 1917).

March 4.—**Oluf Thomsen**: Experimental investigations on the transmissible leucosis in fowls.—**C. Wesenburg-Lund**: Danish freshwater cercariæ, parasitic on the blood. Danish forms have not been examined in detail for some time. Recent research has shown that there are at least forty species. Several are true plankton organisms. Furthermore, the family Schistosomatidæ is represented by the parasite responsible for bilharziasis. During the past year, research in North America, England, France, Germany, and Poland has disclosed species causing serious disease amongst aquatic birds and various skin diseases amongst bathers. Presumably the same organisms are responsible for these diseases in Denmark. Such diseases were previously explained entirely differently.

April 29.—**Niels Bohr**: The properties of the neutron. The remarkably small interaction between neutrons and electrons is a simple consequence of quantum mechanics.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 28[illegible] April 15).—**Edward W. Berry**: The Mioc[illegible]

Idaho. Forty genera have been recognised, of which eighteen no longer exist in the north-western United States. Maples, oaks, beeches, and similar trees form the largest genera, giving evidence of well-distributed rainfall and mild conditions, which were presumably altered by post-Tertiary uplift of mountain ranges.—**Linus Pauling**: Interatomic distances in covalent molecules and resonance between two or more Lewis electronic structures.—**Matilda Moldenhauer Brooks**: The penetration of 1-naphthol-2-sulphonate indophenol, *o*-chloro phenol indophenol and *o*-cresol indophenol into species of *Valonia* from the South Seas. As with other species of *Valonia*, the first dye does not penetrate, and the other two enter in a colourless (reduced) form.—**James S. Potter** and **Maurice N. Richter**: Studies on mouse leukemia. (6) The predominating cell type in line 1. The chromosome number is forty, which is normal for somatic cells of the mouse, and none of the cytological methods used was able to differentiate these cells from similar cells in normal mouse tissue.—**R. J. Seeger**: A critique of recent quantum theories (2). A mathematical discussion directed towards the view that an incomplete interpretation of laws of physics would be preferable to the present principle of indeterminacy.—**Otto Beeck**: The ionisation of argon and neon by neutral argon beams. Argon ions formed by electron impact are accelerated and pass through argon gas, where they encounter atoms of argon and are neutralised; the neutral beam passes into an ionisation chamber containing argon or neon. In both cases, at 50-120 volts equivalent velocity of the neutral argon atoms, the intensity of ionisation produced is practically constant. The results indicate that ionisation by neutral beams is very efficient, and suggest that the neutral atom may play the rôle assigned to the positive ion in discharge through gases. —**F. Zwicky**: Ionisation in gases by ions and atoms. A theoretical discussion on which the experimental work of the preceding paper was based.—**William Duane**: (1) The mass of the electron. Using (*a*) Bragg's formula for reflection of X-rays by calcite, (*b*) Bohr's formula for the Rydberg constant, and (*c*) Einstein's quantum equation and the results of earlier X-ray reflection experiments, the rest mass (m_0) is found to be $9 \cdot 054 \times 10^{28}$; hence $e = 4 \cdot 773 \times 10^{-10}$ e.s.u. and $h = 6 \cdot 557 \times 10^{-27}$.—(2) An instrument for the photometering of the new X-ray lines. The negative of the spectrum is illuminated and a horizontal image of the lines to be examined is projected on to a horizontal slit before a photoelectric cell, through which there is a complete circuit including cell, battery, and galvanometer enclosed within metal boxes. The galvanometer deflexion is observed by a beam of light going to a horizontal slit behind which is a photographic plate. This plate and the photoelectric cell and slit are joined mechanically and move vertically. Thus a curve is traced out the points of which correspond directly to points on the negative of the spectrum under examination.—**Frederick G. Keyes** and **Samuel C. Collins**: The pressure variation of the heat function as a direct measure of the Van der Waals forces. A theoretical discussion and experimental observations. The gas is allowed to escape under a measured pressure through a platinum capillary to a lower pressure, while the capillary is heated electrically to maintain the system at a constant temperature. Experimental values for carbon dioxide and ammonia are in agreement with calculated values. The method is particularly suitable for low pressure and low temperature work.—**Eberhard Hopf**: Proof of Gibbs' hypothesis on the tendency toward statistical equilibrium.—**Hassler Whitney**: Regular families of curves (2).

Forthcoming Events

Congress

AUG. 28–SEPT. 3

INTERNATIONAL PHYSIOLOGICAL CONGRESS (Fourteenth Congress). To be held at Rome.

Official Publications Received

BRITISH

Proceedings of the Royal Irish Academy. Vol. 41, Section A, No. 3: On the Determination of Hamilton's Principal Function. By Prof. A. W. Conway and Prof. A. J. M'Connell. Pp. 17-25. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Joint Board of Research for Mental Diseases: City and University of Birmingham. Annual Report of the Laboratory for the Year ending March 14th, 1932. Pp. 10. (Birmingham.)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by Prof. H. Munro Fox. Vol. 7, No. 3, July. Pp. 181-278. (Cambridge: At the University Press.) 12*s*. 6*d*. net.

Birmingham Bureau of Research on Russian Economic Conditions. Memorandum No. 6: *Wages of Industrial Workers in the U.S.S.R.* Pp. 24. (Birmingham.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 25: Termites (White Ants) in South-eastern Australia; a Simple Method of Identification and a Discussion of their Damage in Timber and Forest Trees. By Gerald F. Hill. Pp. 28. (Melbourne: H. J. Green.)

Forestry Commission. Twelfth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1931. Pp. 43. (London: H.M. Stationery Office.) 9*d*. net.

Proceedings of the Royal Society. Series A, Vol. 137, No. A831, July 1. Pp. iii+242. (London: Harrison and Sons, Ltd.) 12*s*.

Journal of the British Wood Preserving Association. Vol. 2. Pp. viii+104+xvi. (London.) 7*s*. 6*d*.

Index to the Proceedings of the Royal Society of London (1905-1930), and to the Philosophical Transactions of the Royal Society of London (1901-1930). Pp. ii+281. (London: Harrison and Sons, Ltd.) 10*s*.

Medical Research Council. Twelfth Annual Report of the Industrial Health Research Board to 30th June 1932. Pp. ii+48. (London: H.M. Stationery Office.) 1*s*. net.

FOREIGN

The Genetical Factor in Endemic Goiter. By Charles B. Davenport. (Publication No. 428.) Pp. iv+56+4 plates. (Washington, D.C.: Carnegie Institution.)

U.S. Department of the Interior: Geological Survey. Bulletin 829: Geology and Coal, Oil and Gas Resources of the New Kensington Quadrangle, Pennsylvania. By G. B. Richardson. Pp. viii+102+9 plates. Professional Paper 172: Gold Quartz Veins of the Alleghany District, California. By Henry G. Ferguson and Roger W. Gannett. Pp. vi+139+58 plates. 2 dollars. Water-Supply Paper 638-B: Water-Power Resources of the Rogue River Drainage Basin, Oregon. By Benjamin E. Jones, Warren Oakey and Harold T. Stearns. (Contributions to the Hydrology of the United States, 1931.) Pp. vi+35-97+plates 8-25. Water-Supply Paper 708: Surface Water Supply of the United States, 1930. Part 12: North Pacific Slope Drainage Basins. B: Snake River Basin. Pp. vi+191. (Washington, D.C.: Government Printing Office.)

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1931. Pp. 12+2 plates. (Zomba.)

Ministry of Finance, Egypt: Coastguards and Fisheries Service. Report on the Fisheries of Egypt for the Year 1930. By R. S. Wimpenny. Pp. iii+118. (Cairo: Government Press.)

Bulletin of the National Research Council. No. 85: Physics of the Earth, 5: Oceanography. Prepared under the auspices of the Subsidiary Committee on Oceanography. Pp. v+581. (Washington, D.C.: National Academy of Sciences.) 5 dollars.

Records of Oceanographic Work in Japan. Vol. 4, No. 1, June. Pp. ii+244. (Tokyo: National Research Council of Japan.)

Proceedings of the United States National Museum. Vol. 81, Art. 8: A New Species of Cestode, *Crepidobothrium Amphiumae*, from *Amphiuma tridactylum*. By Clarke Courson Zeliff. (No. 2926.) Pp. 3+1 plate. Vol. 81, Art. 10: A Cache of Basket Maker Baskets from New Mexico. By Walter Hough. (No. 2933.) Pp. 3+3 plates. (Washington, D.C.: Government Printing Office.)

U.S. National Museum. Bulletin 100: Contributions to the Biology of the Philippine Archipelago and adjacent Regions. The Philippine Land Mollusks of the Genus Opisthoporus. By Paul Bartsch. Pp. 323-327+2 plates. (Washington, D.C.: Government Printing Office.)

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CONTENTS

Science in Elementary Schools*

THERE has recently been published by the Board of Education a pamphlet summarising the information collected by a panel of H.M. Inspectors since early in 1930 regarding the teaching of science in certain types of post-primary schools, and offering suggestions for further improvement. This pamphlet is of more than usual importance, for the schools concerned are attempting, without the guidance of experience, what amounts to a revolution in educational practice; the aim of the 'Senior School' involving abandonment of the academic tradition in which its own teachers were themselves educated and trained.

Under the general title of 'Senior School' are included Selective Central Schools (308), Non-selective Central and Senior Schools (267), and Higher Tops, Durham (9), giving a total of 584 schools from which information was obtained, and of which about eighty were specially visited by selected inspectors. Of the 144,854 pupils in these schools, 132,199 were returned as taking a science course, the teaching being in the hands of 1391 teachers (913 men, 478 women). The figures make it clear that these new schools as a whole have decided that a course of work in science of some kind is desirable as a part of the normal curriculum for all children. This consensus of practice is a satisfactory sign; but inspection of the details shows that the problem of framing courses suitable for this type of school has not yet been solved, in spite of some praiseworthy efforts.

It must be borne in mind that the ages of the children at these schools generally range from 11+ to 14 years, and rarely to 16 years at the most; and that the great majority of the pupils never again attend any educational institution after they have left school. It is thus obvious that the aim of 'Senior Schools' should be to give a science course as complete as possible in itself as a preparation for ordinary life in the social rank to which the pupils belong; to attempt a course preparatory to more advanced study is a fatal mistake. That the schools have not yet realised this ideal is evident, for while the number of schools in which only one subject is taught is relatively small, no fewer than 264 schools make no provision for teaching biological subjects, and less than half teach both the physical and biological sciences. Boys' schools tend to limit their science teaching to chemistry and physics; and girls' schools, to a

* Educational Pamphlets, No. 89. Memorandum on the Teaching of Science in Senior Schools. (London: H.M. Stationery Office.) 1s. 3d.

less degree, to biology, usually botany; while in many mixed schools, where the happy mean might be expected, the boys take a course of physics, and the girls confine their attention to botany. Briefly, there is too much specialisation, and the outlook is thus narrow and lacking in contact with much of everyday life.

Blame for this unfortunate state of affairs is attributable to more causes than one; but undoubtedly the present condition of the external examinations for which candidates from these schools sit is largely responsible. It is true that the total number of candidates offering science is small—frequently in the single-figure region in any one school; but the examination syllabus inevitably influences, if it does not dominate, that of the whole school. In nearly all these examinations it is possible to present a single science subject; and, naturally enough, this tends to be the only subject studied in the school. Worse still, in physics it is possible to present only one branch; hence boys' schools exist in which the work is restricted to 'heat, light, and sound'.

Another potent factor contributing to the undesirable specialisation lies in the previous education and training of the teachers themselves. Analysis of the qualifications of 599 men teachers whose university records showed them to have attained a reasonable standard in science revealed that 547 have qualifications in physics, 510 in chemistry, but only 30 in botany and 8 in zoology. Among woman teachers the disproportion is less marked; here for every 100 qualifications in physical science there are 67 in biological. It is encouraging, however, to find that science teachers are availing themselves of short holiday courses in order to widen their knowledge and give greater breadth to their teaching.

To solve the problem confronting each of these schools no single cut-and-dried detailed syllabus is possible or desirable. Each school should adapt its science teaching to the special circumstances of its locality, that is, to those of the ordinary everyday life of the great majority of the pupils both during and after the school years. The surroundings and occupations of young men and women in a manufacturing town will be very different from those of persons dwelling in purely rural districts; and it is essential that the school science course should, for each category, be such that the after-school life shall be enriched with intelligent interest in the daily round of work, home life, and recreation.

There is, nevertheless, a certain amount common to the needs of all. Inasmuch as human beings are living creatures and subject to the same laws of life as other organisms, some knowledge of the fundamentals of biology and of the elements of human physiology and hygiene should be given in every school. Such universality would in a short time result in an instructed public opinion in matters of health, and thus in a more healthy, more serviceable, and happier community. Botany, so unreasonably favoured in girls' schools, cannot by itself achieve this. It ought not to be possible in any of the external examinations of these schools for a candidate to offer botany alone or zoology alone. The one subject, biology, embracing the essentials of both animal and plant life, should be compulsory, and should include a few life-histories in both kingdoms, especially of such organisms as are common and of economic or hygienic importance. Details of structure should be introduced and demonstrated only so far as they are needed to render intelligible the more obvious activities of living organisms.

Again, in this age of machinery, 'wireless', and other applications of the various forms of energy, no one, whether in country or in town, can live intelligently without some knowledge of the principles of the physical sciences. The teaching should start from the objects familiar to the child; say, the hot-water radiators or the electric lamps, and should work back to first principles. Interest is thus roused at the outset, and is sustained throughout the series of demonstration experiments designed to find out how the thing acts. In schools of this type, personal practical work by the pupils should not be allowed to occupy more than a small fraction of the time allotted to the science course. It is here that many teachers find it difficult to break away from the tradition in which they themselves were educated, failing to appreciate the great difference between their own past and the pupils' present needs for science. To start a course of physics, as so frequently, with practical mensuration, is a soul-destroying method. Calculation of areas, volumes, and the like is the work of the mathematician: time enough to determine any one of them when the information is actually required in the course of some scientific experiment.

Biology and physics, then, should form the main part of the science teaching in these schools. Chemistry has, of course, claims arising from its importance in industries and in agriculture; but in view of its intrinsic difficulty, of the short time available, and of the tender years of the children, it is recommended that in this subject the teaching

should go little beyond the simple chemistry of air and water, save in special local circumstances.

A further important point is that the several branches of science should not be taught as separate subjects. There are many links and points of contact between them; and teachers should be so trained in the theory and the experimental technique of each as to be able with confidence and success to combine physical and chemical experiments with their biological teaching and demonstrations.

Summing up, the science course in a 'Senior School' should aim at promoting an intelligent appreciation of man and his environment, and for this purpose a new method of approach is necessary. All who are responsible for such courses in Senior Schools should carefully consider the recommendations of this pamphlet; and those in charge at public schools, where the problem for the non-specialist is not widely different from that in 'Senior Schools', might also study it with advantage.

Concerning Mutton and Wool

(1) *Empire Marketing Board. Wool Quality: a Study of the Influence of various Contributory Factors, their Significance and the Technique of their Measurement.* By Dr. S. G. Barker. Pp. 328 + 41 plates. (London: H.M. Stationery Office, 1931.) 21*s*.

(2) *Growth and the Development of Mutton Qualities in the Sheep: a Survey of the Problems involved in Meat Production.* By John Hammond, with a Section in conjunction with A. B. Appleton. (Biological Monographs and Manuals.) Pp. xxvi + 597 + 53 plates. (Edinburgh and London: Oliver and Boyd, 1932.) 42*s*. net.

BIOLOGICAL products are commonly both complex and subject to variability. Research work on their production, whether genetic or nutritional, or even purely an attempt at classification, cannot proceed far before it becomes an urgent necessity to define the nature of the product and to measure its varying characteristics. More particularly is it necessary to consider those differences that are of practical importance.

It is significant that two volumes dealing with mutton and wool respectively should appear at the present time. Both are a response to the need for establishing a precise scientific basis for research upon sheep breeding and sheep nutrition.

(1) The two volumes are widely different in content. This is due to the very different development of knowledge in the two fields. Dr. Barker deals with a subject that has exercised the ingenuity of many workers for well over a century, a subject to which he has himself made important contributions. His book, therefore, is a review of the literature dealing with the wool fibre and its physical and chemical properties, together with related substances such as wool grease and common impurities. The book will undoubtedly prove of the utmost value to research workers in this field, for, until its appearance, there has been no adequate review in English. The literature is peculiarly scattered and many important papers are hidden in volumes that most students find difficult to obtain.

Dr. Barker covers the field with thoroughness, and appends a valuable bibliography. His purpose has clearly been to bring together the material and to give the reader a clear account of the scope and findings of each paper. It is not a critical review and usually each author's conclusions are set forth without much comment. It is more useful to the research worker, however, that the volume should be comprehensive rather than critical.

The book is admirably produced and illustrated and contains numerous tables. The bibliography is made to serve as an authors' index, but there is no subject index. This is an unfortunate omission in a book that will undoubtedly take its place as a very valuable work of reference.

(2) Mr. Hammond's book is the record of nearly twenty years of research. Most workers on animal nutrition have been content to consider only gross weight and chemical composition, and while it is true that much valuable information can be secured in this way, there are many qualitative and quantitative differences that cannot be expressed in these terms. Mr. Hammond states in his preface that he has attempted to approach the problem from the other end by making observations on the product and then working backwards to discover the factors that affect its formation. This novel approach has yielded results of outstanding interest, and Mr. Hammond's observations, fully and clearly set forth in this book, will prove a mine of information to research workers concerned with any aspect of meat production, and will also prove an inspiration to all who are confronted by similar problems in other fields.

In reviewing a book of this size, which contains a mass of detailed tabular information of such an original nature, it is only possible to indicate the scope of the work and to mention in passing one or two of the host of interesting points that are raised.

The book is divided into five parts. The first deals with the rate of growth in live weight

flock of Suffolk sheep. Variations are related to a number of factors such as age, sex, number of young, time of lambing, and so forth. In the second part the argument is carried a stage further. Carcase percentage is considered, again in relation to the factors that affect it. This section also includes data on the relative development of organs, and it is clearly shown that each organ follows a growth curve of its own. Breed differences are striking, and Mr. Hammond makes the interesting suggestion that when the size of a species is reduced, the body decreases more rapidly than the head, and that when a species is increased in size, the body increases more rapidly then the head. This is probably due to the fact that the head reaches its maximum rate of growth early. The third part is a very complete account of variations in the rate of development of different parts of the skeleton, that is, of the basis of bodily conformation. Early maturity is regarded in general as a desirable feature in a meat-producing breed, but Mr. Hammond suggests that this is a more fundamental and inevitable trend than the practical man has perhaps realised, for it is pointed out that the most perfect meat conformation will be found in the type that matures early. "Early maturity and ultimate breed improvement go hand in hand."

The fourth part deals with variation in the proportion of muscle, fat, and bone in the carcase, and includes general observations on the composition of the gain made at different ages and the economic considerations affecting age of slaughter. Mr. Hammond suggests that in the early maturing breeds the point has been reached at which the relatively low rate of reproduction of the sheep is becoming a serious limiting factor. He is doubtful whether the sheep can hold its own in intensive farming unless improvement can be effected in this direction.

The fifth part of the book is written jointly with Dr. A. B. Appleton and is entitled "Study of the Leg of Mutton". It is a minute analysis of the anatomical (and chemical) differences that determine economic value. The section that deals with the histology of muscle is of particular interest and importance. The histological differences are surprisingly large and definite, and are undoubtedly closely associated with variations that determine the edibility of meat.

The last section of the book deals with two factors that affect edibility, namely, tenderness and flavour. Seldom can the cooking of legs of mutton in the kitchens of a Cambridge college have been supervised with such anxious care as on the [illegible] when Mr. Hammond entertained his friends at remarkable feasts! The individual muscles were dissected out, and the guests, all men used to scientific investigation, were asked to place the muscles in order as regards tenderness and flavour. The two characteristics vary independently; for example, the biceps femoris heads the list for tenderness, but is lowest for flavour except for the psoas major. The semimembranosus heads the list for flavour, but occupies a lowly position for tenderness. The correlation between tenderness and small size of muscle fibre is 0·71, and between tenderness and 'fineness of grain' 0·33, whereas the correlation of this characteristic with paleness of colour and amount of marbling (in any one animal) are only 0·20 and 0·11 respectively. The correlation between high flavour and dark colour is 0·45, and between high flavour and coarse grain 0·48, while there is no correlation with fibre size or with amount of marbling. So the book ends with the clear indication that even the most elusive characteristics of a variable product can be related to what can be weighed and measured.

There are full indexes of authors and subjects and a copious bibliography, though one may regret that the usual biological practice has not been followed, in that titles of papers are omitted. The illustrations are admirable and the tables very clearly arranged. The whole arrangement and production of the volume are delightful and reflect the greatest credit on the editors of the series and on the publishers. J. A. FRASER ROBERTS.

Diatoms

Kryptogamen-Flora von Deutschland, Österreich und der Schweiz. Von Dr. L. Rabenhorst. Zweite vollständig neu bearbeitete Auflage. Band 7: *Die Kieselalgen Deutschlands, Österreichs und der Schweiz mit Berücksichtigung der übrigen Länder Europas sowie der angrenzenden Meeresgebiete.* Von Dr. Friedrich Hustedt. Teil 1. Pp. xii + 920. 63 gold marks. Band 9: *Die Flechten (Lichenes) Deutschlands, Österreichs und der Schweiz mit teilweiser Berücksichtigung der übrigen Länder Europas.* Herausgegeben von Dr. Alexander Zahlbruckner. Abteilung 4: *Cladoniaceen und Umbilicariaceen.* Hälfte 2: *Die Gattung Cladonia.* Von Dr. Heinrich Sandstede. Lief. 1, 2. Pp. 531 + 34 Tafeln. 47·50 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930–1931.)

SINCE the publication of Van Heurck's synopsis and Peragallo's treatise on the marine diatoms of France, no comprehensive systematic treatment

of these difficult forms has appeared, for Schmidt's "Atlas der Diatomaceenkunde", most valuable as a work of reference, scarcely fulfils these functions. While the contributions of Meister, Boyer, and especially the new edition of Bacillariales in the "Süsswasserflora" by Hustedt, each serve a useful purpose in their respective fields, a treatment covering the majority of known forms has long been needed. Fortunately, it has fallen to the lot of Hustedt to undertake this work, and the volume now under review amply testifies to the thoroughness with which he is carrying out his task. It comprises introductory matter occupying some two hundred pages, as well as the taxonomic treatment of the centric forms.

The former deals with the structure, life-history, and physiology of diatoms, as well as with the technique involved in their preparation and study. In a taxonomic work most room is naturally given to a consideration of features of major systematic importance, and considerable space is devoted to a discussion of the structure of the cellular envelope. It is unfortunate that details of the author's recent work on the raphe of Epithemioideæ, Nitzschioideæ, and Surirelloideæ could not be included, and one may express the hope that they will find a place in later sections. Some sections (for example, that dealing with chromatophores) would have gained by the mention of more abundant examples. The citation of literature is not always satisfactory; thus, one seeks in vain in the respective bibliographies for the references to Heinzerling and Richter cited in the third and fourth sections, although they are mentioned elsewhere. More particulars as to the occurrence and general biology of diatoms would have been useful; their periodicity is barely mentioned, and there is no reference to Pearsall's work. With most of the views expressed in the introduction one will be in general agreement, but the statement on p. 9 as to the haploid nature of centric diatoms and the occurrence of reduction during germination of the zygote, never very probable, is scarcely in accordance with recent work. As a whole, however, the introduction constitutes a useful summary of present knowledge.

The taxonomic section dealing with Centricæ, the classification of which broadly follows Schütt's system, merits unstinted praise. The keys are well constructed, but in the larger genera the species might usefully have been numbered, so as to facilitate the finding of them in the descriptive part. The numerous difficult forms are illustrated by excellent text-figures, many original and quite as clear as the figures usually furnished on plates. The concise diagnoses are often accompanied by critical remarks, adding greatly to the usefulness of the work, which has clearly been prepared with care by one who is a master of his subject.

Sanstede's monograph of the genus *Cladonia* is a work that will be highly valuable to the specialist. The species are grouped in the three subgenera *Cladina*, *Pycnothelia*, and *Cenomyce*, and are illustrated on a considerable number of plates. A particularly useful feature is the clear distinction of different habitat-forms.

F. E. FRITSCH.

Modern Physical Chemistry

(1) *Physical Chemistry: an Elementary Text, Primarily for Biological and Pre-medical Students.* By Prof. L. J. Gillespie. (International Chemical Series.) Pp. ix + 287. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 16*s.* 6*d.* net.

(2) *Outlines of Theoretical Chemistry.* By Dr. F. H. Getman. Fifth edition, revised and largely rewritten by Prof. F. Daniels. Pp. ix + 643. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 22*s.* 3*d.* net.

(3) *Industrial Chemical Calculations: the Application of Physico-Chemical Principles and Data to Problems of Industry.* By Prof. O. A. Hougen and Prof. K. M. Watson. Pp. vii + 502. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 28*s.* net.

(4) *The Kinetics of Homogeneous Gas Reactions.* By Dr. L. S. Kassel. (American Chemical Society Monograph Series, No. 57.) Pp. 330. (New York: The Chemical Catalog Co., Inc., 1932.) 6.50 dollars.

(1) PROF. GILLESPIE'S book is a courageous attempt to bring the modern conceptions of physical chemistry within the range of comprehension of what he calls "biological and premedical students". If by the latter we understand students preparing for first medical examination in Great Britain, then the book will be found too difficult. For slightly more advanced students of physical chemistry, whether medical or not, it will be found both stimulating and helpful. The emphasis throughout is on biological problems, in which physical chemistry is recognised as perhaps the most important guiding principle, and the range of subjects selected is admirable for this field. More attention might, it is true, usefully have been given to questions of reaction velocity and catalysis, the chapter on these subjects being somewhat adequate and out of proportion as com-

the rest of the book. After all, there could be no life if everything were in equilibrium or pseudo-equilibrium.

In many cases deductions of formulæ are given, in some cases by simple and ingenious methods, and this part of the book is well worth study by teachers and students of general physical chemistry. The thermodynamic treatment is the most prominent, the so-called free energy being introduced and used in a very interesting and instructive way. The perplexing question of the signs of electrodes and cells is fully dealt with, the author adopting one of the American conventions in the first part of the book, and the other in the second part (pp. 133, 245). The activity conception is clearly explained and is used throughout, and there is a good chapter on the Donnan equilibrium.

This book is a very good elementary account of certain selected aspects of physical chemistry, and is certain to prove useful both to teachers and students.

(2) Prof. Getman's textbook, first published in 1913, represents, as it were, the extrapolation of the classical type of treatise initiated by Ostwald's "Outlines of General Chemistry" into the modern period. The fact that it is now in its fifth edition shows that it is a highly successful and valuable work, and in its modern form it reflects faithfully the important outlines of the science. Prof. Daniels had a good stock on which to graft the new ideas, and he has performed his duty admirably, the whole organism now being as one.

A very praiseworthy feature is the inclusion of descriptions of experimental methods, which have tended to disappear from some books, leaving the incorrect impression that physical chemistry is a branch of mathematics. The sections of electrochemistry are particularly good, careful attention being given to all points which usually cause difficulty; and the introduction of activities, with good examples of their application, makes this part of the book a real help to teachers and students. The chapter on thermodynamics gives a good summary of the American system of calculations. Many problems are given, and answers to some are provided.

A few minor points of criticism may be mentioned for consideration by the authors when a new edition is in preparation. In considering viscosity, the question of turbulent flow might be mentioned; the so-called 'factors' of energy are introduced (p. 111), but those of thermal energy are surely temperature and entropy, not temperature and heat; and in any event it is not true to say that "all forms of energy may be expressed as the product of two factors", since radiation cannot be so expressed; the derivation of the Gibbs-Helmholtz equation on p. 133 is not clear, although it follows the usual lines, since the student does not see that equation 67 refers to a cycle and equation 69 to an isothermal process; the "approximate form" of Maxwell's distribution law, considering distribution in two dimensions only, although it "may be sufficiently accurate for most work in chemical kinetics", cannot represent the facts, and its use in other fields has led to mistakes; on p. 474 it would perhaps have been better to have given the deduction of the formula for the antimony electrode rather than for a hypothetical case.

(3) Chemical engineering is a branch of applied physical chemistry, as the authors of "Industrial Chemical Calculations" recognise by their sub-title. The change-over from the lecture room and laboratory to the engineer's office and the works is partly a matter of arithmetic, and very few additional ideas or conceptions are involved. The physical chemistry, however, must go somewhat beyond what the student usually learns in a degree course, and it must be brought into intimate relation with practice.

Such a book as the present one will go a long way in helping the student to bridge over the transition period, and it should be valuable to men going into industry. As the authors say, the method of tackling a calculation needs careful consideration. Most students, in working out a gas volume problem in which Fahrenheit temperatures are involved, would first convert these to centigrade and then proceed on the old familiar lines, with needless loss of time and energy. On the other hand, the use of short cuts is often dangerous, and, as the authors say, results only in the saving of time for the calculator who is experienced and proficient. "In industrial practice it is necessary not only to obtain a solution rapidly, but also to present this solution in such form that its correctness is certain." There are well-tried ways of doing this, and they are explained in the book.

Many problems are worked out in the text and several are given for solution. It would have been very much better to have given answers to these, since, unless the student has always a teacher to fall back upon who is willing to work out these problems, he does not know whether he is making progress or not. The authors provide good tables of constants and data, and give references to literature.

The section on fractional distillation, in view of the great importance of the subject, is perhaps a

little inadequate and should be extended in future editions. The book is one which can be recommended as likely to prove very valuable to students and teachers. It is well written, and the authors have spared no pains in making their presentation of the subject both intelligible and authoritative.

(4) The treatment adopted in Dr. Kassel's interesting and useful book is essentially that of statistical mechanics, which he considers has been the most successful in this field, and of which he gives a condensed but clear account in the opening chapters. The theoretical treatment and the detailed consideration of the experimental data are separated, which makes for clearness, the theory being discussed in the first part of the book and the data in the second, larger, part.

This second part of the book is particularly helpful, since the author has examined the data with great care, involving the recalculation of much experimental material and, incidentally, the revelation of no insignificant number of arithmetical errors in the original papers. The theoretical treatment includes a good critical discussion of the wave mechanical method, of intermolecular forces in imperfect gases and their influence on collision frequencies, and on various types of reaction. This part is clear and sufficiently advanced to be of real utility. After a chapter on experimental methods, the discussion of particular reactions is begun, and the field is very satisfactorily covered.

There is a useful appendix giving numerical values of heats of dissociation. Dr. Kassel's book may be recommended as giving a clear and authoritative account of a field of investigation which has attracted a considerable amount of attention in recent years.

J. R. Partington.

Short Reviews

Firedamp Explosions and their Prevention. By W. Payman and Prof. I. C. F. Statham. Pp. xii + 158. (London: Oxford University Press, 1931.) 12s. 6d. net.

The steady decline in loss of life arising from firedamp explosions in coal mines of itself bears testimony to the precautionary measures which have been developed to minimise this ever-present danger. The authors have embodied in short compass an account, drawn largely from papers published during recent years by the Safety in Mines Research Board, of the properties of firedamp, its possible means of ignition in a mine, and how, by the construction, maintenance, and testing of apparatus used in coal mines, the hazard of explosion may be minimised.

In outlining the statutory requirements for safety lamps, bells, relays, telephones and shot-firing apparatus, details are given of the tests undertaken at the research stations at Buxton and Sheffield. It is of interest to note that more stringent requirements as to the candle power of safety lamps are indicated, for it is held in many quarters that better lighting would prove a most valuable contribution to increased safety. A large section of the book deals also with the design and testing of flame-proof electrical apparatus, the use of which is rapidly increasing. Thus, between 1912 and 1929, the horse power of electrical plant installed in British mines increased by an average of 35,400 a year; without the aid of electrical energy many of our mines could not produce coal to-day at an economic price. The final chapters are devoted to coal-mining explosives and their substitutes, the nature of the flames produced by explosives being well illustrated by photographic records. On all these matters comparison is made with United States and Continental practice.

The book is written authoritatively, is free from typographical errors and well produced, and should be in the hands of all associated with mine management. Being mainly a compilation of statutory tests, etc., it suffers somewhat from 'cataloguing' and would have made better reading had more space been devoted to the historical side. It seems unbelievable that a book on firedamp explosions could have been written without mention of Sir Humphry Davy.

Two Thousand Years of Science: the Wonders of Nature and their Discoverers. By Prof. R. J. Harvey-Gibson. Second edition, revised and enlarged by Dr. A. W. Titherley. Pp. x + 508. (London: A. and C. Black, Ltd., 1931.) 12s. 6d. net.

The fact that a second edition of this book has been called for only a year after the publication of the first is sufficient testimony to its general appeal. In its present form it includes much more information relating to the modern period, while the provision of chronological tables aids the reader to arrive at a true perspective. Dr. Titherley has clearly been at pains to check his facts—no light task in a survey of two thousand years—and though some of the judgments expressed are perhaps a little superficial, the book as a whole forms a reliable and readable guide to the principal course of the development of science.

Such 'popular' accounts of the work of men of science serve a very useful purpose in the modern world, and the pity is that there are so few of them. Admitted that a great deal of present-day scientific theory is beyond the comprehension of the layman, it yet remains true that most of the results, and many of the methods, can be rendered intelligible by skilful exponents; and that the public is eager for such fare is sufficiently obvious from the excellent reception accorded to simple explanations of scientific achievement when authoritatively written. We hope that the example of the present book may be widely followed: meanwhile, in the interests of accuracy, we may perhaps direct attention to a few minor errors that have eluded Dr. T

vigilance. Basil Valentine—if he ever existed—certainly did not publish the "Triumphal Chariot of Antimony" about 1430; the discovery of carbon dioxide is generally attributed to J. B. van Helmont, not to his son Mercurius; the Saracens are probably wrongly blamed for burning the library at Alexandria; Mayow's "spiritus nitro-aereus" is not equivalent to the modern oxygen; and the "Summa perfectionis" is scarcely the oldest chemical book.

Simple Determinative Mineralogy. By H. R. Beringer. Pp. vii + 239. (London: Mining Publications, Ltd., 1931.) 10*s*. 6*d*.

THIS is definitely not a textbook of systematic mineralogy, but a handbook intended to assist students and prospectors in the field determination of mineral species.

The method adopted is based on the recognition of two physical characteristics generally easily and quickly determinable—specific gravity and hardness. Accurate determination of these two properties should serve to restrict any mineral to a more or less small group. Further recourse may then be had to the blowpipe and to the description of the other properties of suspected species.

Practical methods for the determination of specific gravity are dealt with in the first part of the book. Two mineral lists make up the bulk of the text. In one the species are grouped according to specific gravity, the members of each group being listed in order of hardness. In the other the minerals are arranged solely in the order of their specific gravity, and a concise account of their other physical properties is given for each species. Notes are added on their chemical properties. There is also a list of the elements, with a short account of their blowpipe and other chemical reactions.

The author has had many years' experience as a teacher of practical mineralogy in the School of Mines at Camborne, and his method has been in use there for more than ten years. This should be sufficient recommendation of the practical utility of his book.

Key to and Primer of Interlingua: or Latin without Inflections meant to be used as an International Auxiliary Language amongst Peoples of various Mother Tongues. Pp. v + 168. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1931.) 4*s*. 6*d*. net.

THIS excellent little book shows the degree of perfection and range of application of the auxiliary language invented by Prof. G. Peano and his friends. Interlingua, or Latin without inflections, is meant to be used as an international auxiliary language amongst peoples of various mother tongues. Yet in reading through the rules of Interlingua, the glossary, and the interesting reading book, one is bound to find that, if this auxiliary language might satisfy the requirements of Latin races, the Anglo-Saxon languages, and the Slav languages, not to mention the extra-European languages, can scarcely look upon it as a helpful [illegible]. On the other hand, scholars would always prefer Latin to the Interlingua owing to the history and the documents which enshrine it. Further, a language which is spoken with difficulty by a band of enthusiasts and has no literature of its own can scarcely appeal either to the pragmatist or to the lover of artistic productions. The admiration one cannot help feeling for the untiring and disinterested efforts of Prof. Peano's school will never outbalance the deadweight of the irreparable curse of the Tower of Babel. T. G.

East Yorkshire: a Study in Agricultural Geography. By Dr. S. E. J. Best. Pp. xv + 189 + 8 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 16*s*. net.

DR. BEST'S book is typical of the surveys which modern students of geography are making for different areas in Great Britain, and shows how closely geography and agriculture are allied. The method is to survey the country from the various geographical points of view, studying its formation, topography, climatic and other factors, and then to set out the agricultural statistics in map form and discuss the agricultural utilisation of the land in the light of its geographical and topographical features. This book is an admirable example of the aid which agriculture and geography can mutually render.

In a future edition it would be helpful if the author would give an index and a bibliography. The literature of the subject is widely scattered and often diffuse; students would be greatly assisted if a list of the best authorities could be presented to them. The author pays a tribute to the work of his distinguished namesake, Henry Best, who in the seventeenth century published an account of farming in Yorkshire; this book was reprinted by the Surtees Society but has long been unobtainable by students: one cannot help wishing that a reprint were available.

The Birds of Tropical West Africa; with Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria. By D. A. Bannerman. Published under the Authority of the Secretary of State for the Colonies. Vol. 2. Pp. xxix + 428 + 15 plates. (London: The Crown Agents for the Colonies, 1931.) 22*s*. 6*d*.

THE first volume of Mr. Bannerman's work has already been highly commended in these pages, and the second deserves equal praise. The book admirably combines the two purposes of giving a summary of knowledge of West African birds and of providing a working guide to observers on the spot. This volume has also particular interest for European ornithologists, as it deals with the occurrence and habits of many northern species that are known in Africa as migrants. It has already been remarked that publication of the work is supported by the governments of the British territories in West Africa: further aid from the Gold Coast has now made it possible to increase the number of illustrations as compared with the first volume. These include some beautiful coloured plates and many drawings of excellent clearness.

Scientific Research and Industrial Development *

SO far we have discussed only one aspect of the contribution of science to industry. Equally important is the contribution which science makes in technique, the provision of new technical methods. The importance of this aspect of the service of science to industry was enforced on British industry in the early days of the War, when our dependence on Continental firms for all classes of scientific instruments and glassware imposed a considerable handicap in the expansion of the munitions and other industries to meet the war-time demand. Without the instruments of precision for measurement and control of temperature, pressure, refractivity, and other properties, which have been evolved by purely scientific work, industrial development would have been much more laborious. Modern advances in the measurement of high temperatures paved the way for the developments in the metallurgical industries. The development of the newer industries, such as the radio industry, the manufacture of synthetic resins and rayon, is essentially a record of advance closely related to the utilisation not merely of scientific discoveries but also of scientific methods and scientific instruments for purposes of control.

The significance of such methods as X-ray analysis, ultra-violet light, hydrogen ion determination, thermionic valves for control purposes, including automatic control, in industry is only now being appreciated. In high-pressure reactions as well as low-pressure reactions and distillation in very high vacuum, science has provided industry with a whole range of new technique. Scientific work on the two forms of hydrogen has recently simplified the evaluation of industrial catalysts, while almost simultaneously the discovery of the selective properties of a copper chromite catalyst has enormously increased the possibilities of development in the industrial hydrogenation processes.

X-ray methods themselves provide a striking example of the reaction on industry of scientific technique. The recent application of X-ray methods to textile research has led to discoveries relating to the structure of cellulose, wool, and hair which throw new light on just those typical properties of wool which are of fundamental importance in manufacturing operations. As a result, a correct interpretation of the conditioning, dyeing, and other adsorptive processes has been facilitated and a method elaborated for measuring the surface scale structure of the wool fibre which represents the first step towards placing the important technical operations of milling on a scientific foundation. In addition, the discoveries lead to an interpretation of the structure of cellulose which has a direct bearing on the mercerisation process.

Refinements of technique are not the only factor that is continually changing the relations of science and industry and determining the rise of new industries or decay of others. Almost every year sees fresh compounds, formerly curiosities and accessible only by tedious and costly laboratory processes, produced on the commercial scale at a price which allows their use in industry or in scientific laboratories as the raw material of further researches. The papers published in the journal of any chemical society reveal the way in which the scope of scientific research has been enlarged and influenced by industrial advances. The utilisation of waste materials, the delicate balance between by-product and main product, the fall or rise in price of basic materials like sulphuric acid, methyl alcohol, glycerol, which alone may result in new routes to existing products—the war-time shortage of sulphuric acid, for example, led to the development of alternative methods for phenols and amines which have not been entirely replaced by the earlier methods—these are factors which continually emphasise the dynamic character of industrial research and frequently have far-reaching effects on scientific research.

While science has thus provided industry with instruments of precision and methods of attack on technical problems, an important contribution has also been made in the field of industrial health and safety. Until science had revealed the cause of yellow fever and the methods of its prevention and control, the resources of the engineer were inadequate to construct the Panama canal. Merely to walk through a modern dry battery or accumulator factory is to realise how medical science, by examining the causes of industrial poisoning, dusts, and their prevention, has revolutionised conditions of work. Hundreds of industrial processes operate smoothly every day because the scientific study of the properties of materials has enabled working conditions to be devised which satisfy stringent requirements of safety and efficiency. Industrial health is, however, not simply a matter of securing that adequate precautions are taken in the handling of toxic materials or operating dangerous machinery. Science can do much to eliminate such risks, and the accident rate in works where inflammable, explosive, or highly toxic substances are handled under pressures of hundreds of atmospheres or at very high temperatures is frequently below the average in industry.

In addition, although science cannot altogether eliminate the human factor, which is responsible for ninety per cent of industrial accidents, accidents are, however, always unduly prevalent among a comparatively small number of workers. The evidence shows that absenteeism due to sickness is usually abnormally high among the same persons, and that on an average they are also less skilled at their work. Generally it may be said that those who are most suited to their work or environment react the most healthily to their environment, whether we measure the reaction by working efficiency or skill, tendency to sickness, or proneness to accidents.

It is thus evident that vocational selection is of outstanding importance as much from the point of view of industrial safety as from that of in-

* Continued from p. 265.

efficiency. No more valuable work is being done by the National Institute of Industrial Psychology than that which the Institute is carrying out in this field, and as a result of the application of scientific methods remarkable progress has already been made. In spite of the cramping influence of unemployment on the application of some of the newer methods of vocational selection and guidance which have been elaborated, it has been demonstrated that we can at any rate avoid placing in dangerous positions those peculiarly liable to accidents, and the policy of eliminating the unfit before and not as a sequence to accidents is not utopian. A classification into risk classes according to personal characteristics has already been indicated as possible.

The part played by science in securing improved and safer conditions of labour is often overlooked, but the work of the Industrial Health Research Board alone would demonstrate the importance of scientific research in this field. Industrial physiology, of course, is only one section of the field of scientific management, but it is the section in which the most important modern developments have occurred. During recent years the study of industrial physiology and psychology has elaborated methods of preventing strikes and of promoting co-operation between the different organisations of production which are to-day part of the scientific organisation of labour in America. These researches have the same object as the strict application of Taylor's principles in factory and workshops. The success of such work is demonstrated by the changed attitude of the workers, who recognise that attempts made to increase production have become more humane and devote more attention to the human side and the health of the operators.

Much of the work of the Industrial Health Research Board is only preparatory, but conclusions have already been reached which involve no revolutionary changes, and, indeed, only place on a scientific and statistical basis the empirical practices of progressive firms. The value of such results is demonstrated by the fact that they have already been adopted in certain branches of industry, and more widespread acceptance would greatly increase their utility. Scientific research in industrial physiology and psychology is continually improving conditions of work so that both the health and efficiency of the worker are improved, and it is now being applied to ensure that, so far as possible, young persons entering industry are fitted into occupations for which they are temperamentally suited.

It is against this background that we have to place the constructive plans of science for our social and industrial future, but the present economic position of the world has led to certain questionings as to the part which science has to play in the future. Leaders like Sir Harry McGowan have perceived that scientific and technical progress have far-reaching reactions not only on industry but also on the finance and economics of the whole State. [illegible]tific discoveries and their application in in[illegible] dislocated the major balance between industrial and agricultural production, and have threatened the whole social, financial, and political structure of our civilisation. Sir Harry McGowan uttered no idle warning when he hinted at the possibility of our common civilisation perishing through our inability to control the forces which applied science primarily has created. Under the influence of science, not only industry but also accepted views of trade and competition are changing their value, and policies such as free trade and protection acquire a new significance.

Sir Harry McGowan has urged that the policy of industrial co-operation which has developed notably in chemical industry under such forces should be extended into the more difficult field of international co-operation—as indeed has already been done in some few branches of industry, though with what success it is difficult as yet to say. As an aid to such control or development, Sir Harry McGowan visualises a Minister of State devoted to the task of promoting the co-ordinated reorganisation of all our industries, and beyond this an international chemical council to provide chemical industry with a world-wide range. The effective rationalisation thus secured would stabilise development and co-ordinate or expedite research.

There is, however, even now much confusion between rationalisation and the processes of mere amalgamation or cartel which involve no scientific planning or management, and this confusion tends to retard progress. In addition it has to be admitted that in spite of the contribution to industrial progress which science has made during the last century, there are still many sections of industry where scientific research has yet to be recognised as one of the principal avenues of progress. Of this fact the annual reports of the Department of Scientific and Industrial Research provide plentiful evidence, and it will be sufficient to refer to the poor response of the shipping and shipbuilding industries to the offer of the Department to provide half the cost, up to £10,000, of erecting a second William Froude Tank at the National Physical Laboratory for research in connexion with ship resistance and propulsion and tests on ship forms, propellers, etc. In consequence of the congestion of work in the existing tank, not only was research being hindered, but also orders for testing were accumulating to such an extent that they were frequently withdrawn and sent to the Continent, where in recent years similar facilities have greatly increased. It is obvious that if the testing of ship designs is better carried out abroad, orders for construction are likely to follow them abroad. By its failure to respond to this offer the shipping industry clearly was committing suicide, and had not the Advisory Council, in view of the vital importance of this industry to the nation, revised its recommendation and suggested that the whole capital cost of a new tank should be provided initially by the State, the depression in the shipping and shipbuilding industries must inevitably have increased to a point from which any recovery of competition with Continental rivals would have been impossible.

If, however, there are important sections of industry which have still to learn that, while scientific research cannot provide a ready-made solution of our present industrial difficulties, it does point the road along which persevering effort may enable industry to find a way out of those difficulties, it is important to remember that there are accordingly industries the difficulties of which are due less to economic conditions than to neglect of scientific method and research in the past. This is essentially the mark of defective leadership. Such industries are unlikely of themselves to evolve any constructive plans on broad enough lines to serve the national and not merely individual interests and to eliminate the more wasteful forms of competition and overlapping. The scientific planning, which Capt. Macmillan and his followers see as a logical necessity under a tariff policy, cannot be expected of them, and there is, on the contrary, the danger that protection will be used by industries of this type to bolster up the inefficiency of the past. There is every reason to insist that protection should only be afforded to these industries on the understanding that they definitely put their house in order and re-orientate their attitude to fundamental research. They must undertake to carry out investigations designed to yield a reserve of fundamental knowledge which can equally assist in tiding over bad times and in strengthening the industry to meet independently competition from abroad.

The Electrification of British Railways

THE International Electrical Congress was opened at the Sorbonne, Paris, on July 5. More than a thousand delegates representing thirty-one countries attended it. There were several papers on electric railway engineering, most of which discussed the history of electric traction and the modern practice of using direct current at 3000 volts on the railway side of the substations. A paper by Sir Philip Dawson discussed the electrification of British railways.

Sir Philip pointed out that two factors have notably influenced the development of electric traction on British railways. The first and most important was the grouping of numerous small railways into four large companies which took place shortly after the War. The Southern Railway serves the south-east and south-west of England, the track being equivalent to 4000 miles of single-line railway. This figure does not include the lengths required for sidings and for garaging railway carriages. The Great Western Railway serves Wales and the west of England, and if we neglect a few small Welsh railways, was practically unchanged by the grouping. The equivalent track length is about 6550 miles. The London, Midland and Scottish Railway serves the west side of the country from London to the north, the equivalent itinerary of track being 13,600 miles. The London and North Eastern Railway serves the north-east of England and Scotland, the equivalent length of the track being 7100 miles.

Many of the companies which were absorbed by these groups were pioneers of electrification and were eager to extend the electrified portions of their lines. So far back as 1904 the Lancashire and Yorkshire Co. electrified the lines between Liverpool and Southport, and just before the War so also were many lines around Manchester. In 1904 the North Eastern Railway Co. had electrified the suburban lines around Newcastle. The London, Brighton and South Coast Railway had very ambitious schemes for electrifying its lines, and the South Eastern and Chatham Railway had actually passed the contracts for electrifying all its suburban services. In several cases the 'grouping' greatly altered the policy of the original companies.

On railway lines where the traffic is heavy or where the gradients are steep, electrification has many advantages. In industrial districts where the density of the population is great, electric railways are particularly useful. These regions generally follow coal seams. In Scotland, for example, there is one from the east to the west between the Clyde and the Forth. To electrify the line between Glasgow and Edinburgh would be a very promising project. In the north of England there are many large coal mines extending through Durham to Cumberland, the coal area covering a space about fifty miles long and twenty miles broad. There are isolated coal mines in other districts, and there is a coal district in South Wales having a length from east to west of about seventeen miles and a breadth of about twenty miles. Leaving the towns out of account, the density of the population varies between 500 to 1000 inhabitants per square mile. No region of the world can compare with Greater London, which within an area of about 460 square miles contains a population of 12 million inhabitants—a population which is greater than a quarter of the total population of Great Britain, more than half that of Belgium, and equal to three times that of Switzerland.

The Southern Railway has little mineral traffic. It serves all the country south of the Thames and depends largely on its local traffic. The Great Western Railway has important mineral and goods traffic. It serves the south of Wales and the tin mines of Cornwall. The London, Midland and Scottish Railway serves Scotland and the Midlands of Lancashire and Yorkshire. It serves the important ports of Liverpool and Glasgow. The London and North Eastern Railway traverses the great industrial regions in the north of England and in Scotland. In these four railways the receipts from the mineral and merchandise traffic are 25, 57, 59, and 64 per cent of the total traffic receipts respectively.

The other important factor affecting the use of electric traction in railways was brought into existence when the Act of Parliament of 1926 created the Central Electricity Board to control the production 'in bulk' of the electricity generated

Britain. The grid now practically joins up all the 'effective' generating stations. The overhead lines are roughly parallel to many of the main railways.

The Southern Railway inherited from the London, Brighton and South Coast Railway a very flourishing suburban electrified system. Had not the grouping altered matters, it was the intention of the directors not only to finish the electrification of all their suburban systems, but also to work electrically the whole of the main lines as far as Worthing, Brighton, Eastbourne, and Hastings. Taking into account the fact that most of the lines were actuated by direct current, the Southern Railway adopted the d.c. system as the standard. It is still engaged in electrifying the passenger lines from London to Brighton and Worthing on this system. Its electrical lines at present are equivalent to about 750 miles of single track, besides the mileage required for side tracks, garaging purposes, etc. It possesses no electric locomotives, using 881 electrified motor carriages. Only a few miles of the Great Western Railway are electrified. The London, Midland and Scottish Railway has electrified the lines between Liverpool and Southport, Lancaster and Morecambe Bay, and Old Broad Street to Watford. The London and North Eastern Railway has only electrified a suburban section at Newcastle and a goods line in the neighbourhood of Sunderland, from Newport to Shildon. On the Newport line, electric locomotives are used. There are also several lines of purely local interest such as the Underground Railways of London.

The Weir Commission was appointed by the last Government to examine the economic and other aspects of the problem of electrifying the main railway lines of Great Britain. The report was published in March of last year, and confirmed the views of those engineers who held that electrification would lead to important economies and would be a boon to the country. The working results obtained by several electric railways in other countries also support this conclusion. In France particularly the electrification of the main lines has been very beneficial. It is pointed out that although Great Britain was the pioneer of steam railways it lags behind several other countries in electrifying its railways.

Sir Philip Dawson has made special studies of the main lines of the London, Brighton and South Coast Railway and of a project for electrifying the greater part of the main lines of the Great Western Railway. He finds that for slow goods trains the mean velocity is increased 30 per cent by using electric traction, and that for ordinary passenger trains the mean speed can be increased 25 per cent. The cost of repairs, renewals, and upkeep of locomotives is approximately 40 per cent of that of steam railways. This agrees closely with the estimates made by other engineers. Adding together the total capital required for electrifying all the railways in Great Britain, the economies directly attributable to this change would show a gain of 7-10 per cent upon the capital employed.

The quantity of energy necessary to supply a railway depends on local conditions and on the 'ton miles' required by different kinds of trains. A rough estimate can be made of the cost by examining the corresponding costs of electric railways abroad. Taking this as a basis and assuming the average cost of the ton mile on British railways, it is estimated that the 'maximum demand' for direct current from the railway substations would be of the order of 1·5 million kilowatts. To get the average load the mean factor is assumed to be 0·5. Hence the annual consumption on the d.c. side of the railway substations would be about 6500 million kilowatt hours a year.

If the electrification of the railways of Great Britain were begun at once, it would be finished by 1950. Assuming that the expected load on the 'grid' at that date is realised, the demand of the railways would be a fifth of the total output from the grid. The maximum of the railway demand from the grid would be about ten per cent of the total demand. To convert the standard three-phase a.c. supply into direct current, mercury rectifiers would probably be employed. Assuming that this is done, the efficiency of the conversion would be 84 per cent. Estimating that the cost of a kilowatt hour at the generating station would be 0·25*d.*, the cost for the d.c. unit supplied to the railway would be 0·495*d.* This compares excellently with the 0·5*d.* unit given in the Weir Report. Adding on the cost of operating the substations, we find that the total cost would be 0·55*d.*

The regular supply of energy taken by the electrified railways from the grid would react most favourably by lowering the general price of electricity. The electrification would necessitate the construction of about ten new power stations, for which the cost would be appreciably less than that of existing stations, thus contributing to the general lowering of the price of electricity. The necessary great increase in the number of substations would make it possible to supply electricity economically for general purposes to new areas. It will be seen that the conclusions Sir Philip Dawson draws will encourage railway engineers to proceed with their electrification schemes.

Obituary

PROF. GRAHAM LUSK, FOR.MEM.R.S.

AN investigator whose enthusiasm in the pursuit of knowledge never waned; a man who never wavered from the high standards of work and conduct which he set for himself in youth, and whose qualities of mind and heart endeared him to all; a teacher who always gave of his best: such was Graham Lusk. As such he will be greatly missed in many centres by a multitude of colleagues, friends, and pupils. From the beginning of his adult life to its end—for more than forty years—he devoted himself to the study of the problems of

animal metabolism and nutrition. His first paper, published in 1889, dealt with human diabetes, and his last, in 1931, was concerned with the influence of the thyroid upon phloridzin diabetes in the dog. Lusk himself found pleasure in remembering that in 1871 a paper of his father's upon diabetes was published, so that in each decennium for sixty years articles on that subject bore the family name.

Graham Lusk was born at Bridgeport, Connecticut, on Feb. 15, 1866. His father, W. T. Lusk, was a physician of high professional and social standing, who before and after the American Civil War, in which he took part, studied at many European centres. On his advice his son refrained from taking a medical degree, as the deafness from which the latter suffered, then and always, would have made professional practice difficult.

The elder Lusk had a firm belief in the importance of chemistry to physiology and medicine, and Graham therefore went to Germany to obtain, as he himself has said, a sufficient knowledge of physiological chemistry to give him a broader background than that possessed by the medical chemists of the day. At the age of twenty-one years he went to Munich to work under Carl Voit, but found that he could not at once enter the research laboratory. He had first to spend a year in listening to Voit's lectures and in attending so-called practical classes, in which students stood for two hours watching the professor perform experiments. After this probation he was allowed to join the research community, and from the first made a good impression upon Prof. Voit and his staff. The first product of his work was the paper on diabetes already mentioned.

Lusk acquired great affection for Voit, and never failed to speak and write of him with praise and gratitude. He displayed equal loyalty to his other great teacher, Max Rubner, with whom he continued a lifelong friendship.

Lusk's own work, carried out first at Yale and then for more than thirty years at Cornell Medical College, where he held the chair of physiology, reflected the influence of the two teachers he so much admired. It combined the methods that each of these in turn had developed for the study of metabolism: Voit's chemical technique and Rubner's appeal to calorimetry. Lusk's employment of the latter came for the most part after the first classical experiments of his American *confrères*, Atwater and Benedict, had been done; but while these were mainly concerned with the energy balance-sheet of human metabolism, Lusk used the calorimeter rather as a control for chemical studies.

Lusk explored very many aspects of metabolism. Among his special interests were the fate of ingested carbohydrates and the sources of endogenous sugar. His first work under Voit had brought evidence against the then current contention of Pflüger that sugar could not arise in the body from protein. In the early 'nineties, controversy on this point was so bitter in Germany that Voit was astonished to hear that Pflüger had consented to speak to the young author of the work in question! It fell to Lusk in later years not only to supply some of the evidence which finally compelled the conversion of Pflüger, but also to give precision to our knowledge of this incident in metabolism by determining with exactness the maximal amount of sugar which each individual amino acid from protein can yield in the animal body. This he did by administering known amounts of each to phloridzinised dogs and estimating the extra sugar which the animal excreted in consequence. He made indeed, during the course of several years, an intensive study of phloridzin diabetes, and thereby acquired important information concerning various aspects of metabolism.

An aspect which long interested Lusk was that which Rubner had termed the 'specific dynamic action' of foodstuffs. As is now so well known, the consumption of food, but especially the consumption of protein, increases *per se* the heat output of the resting body. If what we now call the basal metabolism of a typical animal be taken as 100 calories per day, and if these 100 calories be administered to the animal in the form of each of the several foodstuffs on different days, then the heat production of the still resting animal after receiving meat protein will rise to about 130 calories, after glucose to about 106 calories, and after fat to about 104 calories. These, according to Lusk, are typical average results. Rubner's explanation of the high figure for protein was that the extra heat corresponded to the free heat of certain thermal chemical reactions in *intermediary* metabolism, probably localised in the liver and representing energy not available for muscular or general tissue activity. Protein differs from carbohydrate and fat in that, whatever the current nutritional needs, the products of its digestion promptly undergo change in the body; a fact demonstrated by an immediate rise in the excretion of nitrogen. Unlike fat or carbohydrate, protein when administered in excess of contemporary needs is not stored as such, but only that moiety is stored which is capable of yielding sugar and therefore glycogen. In any event, the nitrogen of its products is removed before they serve as a source of utilisable energy. Such preliminary reactions thus give origin to that output of heat which is independent of activity.

Such was Rubner's view, and Lusk set himself to obtain experimental evidence in support of it. Unexpected results, however, led him to hold for a time a quite different view of his own. He studied the specific dynamic action (in Rubner's sense) of individual amino acids from protein, and established the interesting fact that while the administration of some among them causes a marked increase on the output of heat from the body, others have no such effect. Rubner, rather over-simplifying a statement of his views, had suggested that the extra heat of protein administration might be considered to come from the direct oxidation of that part of its molecule which is incapable of conversion into sugar. Lusk thought he had disproved this. Glycin and alanine, for example, he

to exert a marked specific dynamic action, while (as could be demonstrated in the phloridzinised animal) they can nevertheless, after de-amination, be wholly converted into sugar. On the other hand, glutamic acid exerts no dynamic action whatever, and yet only three out of its five carbon atoms appear in its yield of sugar. Such results as these, together with other experimental evidence, led Lusk to believe that the extra heat output which follows on protein consumption is due to a direct stimulation of general tissue activity. The stimulus is due to certain constituent amino acids or to certain primary products of their breakdown.

Such a view, if confirmed, would have justified the term 'specific dynamic action' better than the conceptions of its originator. Nevertheless, further work by Lusk himself, and some by others, has rendered the view untenable. Other explanations have been since advanced, but none seems entirely satisfactory. It is probable that the contributory happenings are complex, and that we at present lack sufficient knowledge of the chemical details of intermediary metabolism for full understanding of the phenomenon in question.

I have dwelt upon Lusk's dealings with this elusive problem because it was one which greatly interested him, and his study of it well illustrates his method of applying calorimetry to matters of detail. He never had any difficulty about giving up a theory of his when it ceased to account for facts. He said it cheered him to remember Marat's characterisation of Lavoisier, "a charlatan . . . who changes his theories as he does his shoes". In successive editions of his book he is always frank in admitting a personal change of view, and in the last he deals faithfully with all the evidence bearing upon the nature of specific dynamic action so called. This book, the "Elements of the Science of Nutrition", of which the fourth and last edition was published in 1928, is encyclopædic in its dealings with the literature. It lacks perhaps logical sequence in presentation, and the relative value of conflicting evidence is sometimes left unappraised; but it is written without bias, and contains abundant suggestions which have stimulated research in many quarters.

Lusk was too gentle to be a severe critic, but he was capable of intense indignation upon adequate cause. Certain opinions concerning aspects of metabolism he held with extreme firmness. He would not, for example, admit that fat could be converted into sugar in the body, and refused to believe that sugar is the sole immediate source of energy for muscular activity.

It will be recalled that, together with R. H. Chittenden, Lusk represented America on the Inter-Allied Scientific Food Commission in 1917. He frequently visited Great Britain, where he and Mrs. Lusk had many friends. Shortly before his death, on July 18, he expressed his deep appreciation of his election to the foreign membership of the Royal Society, and the Society itself will be always glad that the honour was offered in time to give that pleasure.

F. G. H.

SIR WILLIAM WILLCOCKS, K.C.M.G.

WITH the death of Sir William Willcocks, on July 28, there passed out of the engineering world and Egyptian everyday life one of the original band of engineers who helped to rescue that country from the financial bankruptcy into which it had been led by Ismail Pasha. Born in India in 1852, Willcocks passed brilliantly through the Thomason Engineering College, Roorkee, and gained his first irrigation experience in that country during eleven years' service with the Irrigation Department of the United Provinces.

Willcocks was brought to Egypt in 1883 by Sir Colin Scott Moncrieff, and at once devoted himself to the reorganisation of the irrigation system on which that country's prosperity almost entirely depends. On arrival he was given charge of the provinces of Gharbieh and Menoufieh, which lie in the Delta between the two branches of the Nile and are among the richest of the provinces. He immediately realised the urgent necessity for the construction of regulating works at the heads of canals so as better to regulate their flow and at the same time reduce the enormous silt deposits which not only impaired their efficiency but also called for intensive work of clearing by the forced labour system known as the 'corvee'. It was not long before this imposition, which had annually compelled 230,000 men out of a total population of 6,000,000 souls to work for about 170 days without pay, was abolished.

Willcocks' district then covered an area of some two million acres. With characteristic energy he used to tramp all over the country on foot, and soon became a familiar figure and almost a household word with the 'fellaheen'.

It was on account of his resourcefulness and courage that Willcocks was entrusted with the diagnosis of the 'disease' which, since their completion in 1861, had beset the two barrages, or dams, which Mougel Bey had designed and built at the heads of the Rosetta and Damietta branches of the Nile. Before they had been repaired, he courageously used them for raising the water level so as to give the canals a more plentiful supply. This was achieved by throwing a bank of loose rubble across the bed of the Rosetta barrage, thereby reducing the pressure of water which it had to bear, and, although signs of weakness did develop, the country profited for that season. The reconditioning of the barrages then followed. He was responsible for the remodelling of many canals and their attendant regulating works.

Having done so much to improve the system by which water is distributed, Willcocks was asked to devise a scheme for supplementing the supply of water at seasons when the natural flow of the Nile is deficient. His surveys of Nubia which resulted from this campaign, and his measurements of the flow of the Nile, find their parallel in the work done by the 'savants' of the Napoleonic expedition. The principles which he enunciated were those finally adopted in developing the Assuan reservoir scheme, which has up to the present day been

Egypt's only artificial reservoir. To engineers in Egypt, and in fact all over the world where irrigation is practised, his writings, reports, and principles have provided inspiration and guidance.

In 1901 Willcocks turned his attention to the irrigation of an area of three million acres in South Africa, and in 1911, after he had retired from the Egyptian Government service, he concentrated on the development of irrigation in Mesopotamia. He lost no time in giving practical effect to his schemes for the Hindia Barrage, and its attendant canals were already in operation before the outbreak of the War, and his maps and surveys proved of great value to those engaged in the campaign.

On the completion of the Assuan Dam, Willcocks was made a C.M.G., being later rewarded with the K.C.M.G. for his services in South Africa.

Willcocks was fond of controversy. In consequence of his strong personality he was somewhat intolerant of adverse opinion, and while there can be little doubt that his outspokenness estranged him from many people, subsequent events have vindicated many of his opinions, and the final account, when struck, will probably show a balance largely in his favour. Egyptians and engineers in general will mourn the death of a man to whom they are deeply indebted. A. B. B.

WE regret to announce the following deaths:

Prof. Louis W. Austin, of the staff of the U.S. Bureau of Standards, who was an authority on physical measurements and radio transmission, aged sixty-four years.

Sir William E. Clegg, C.B.E., pro-chancellor of the University of Sheffield and chairman of the Applied Science Department of the University, on Aug. 22, aged eighty years.

Prof. Harold Jacoby, formerly professor of astronomy at Columbia University, known especially for his work in the application of photography to astronomical research, aged sixty-seven years.

Mr. Herbert Knapman, registrar of the University of Reading, formerly lecturer in mathematics in University College, Reading, on Aug. 14, aged fifty-two years.

News and Views

Foreign Guests of the British Association at York

THE following is a list of foreign visitors to the British Association for the York meeting who are attending in an official capacity either as guests or as representatives of foreign associations: *Section A* (Mathematics and Physics): Dr. W. Meissner, Physikalisch-technische Reichsanstalt, Berlin-Charlottenburg; M. le Duc de Broglie, Paris; Prof. W. J. de Haas, University of Leyden, Holland. *Section B* (Chemistry): Prof. J. Meisenheimer, Chemical Institute, Tübingen; Prof. H. Staudinger, University of Freiburg im Breisgau; Prof. Max Bergmann, Technical High School, Dresden; Prof. H. Kessener, The Hague. *Section C* (Geology): Prof. P. Pruvost, University of Lille. *Section E* (Geography): Dr. J. Georgi, Hamburg. *Section H* (Anthropology): Dr. Axel Boethius, director of the Swedish School of Archæology, Rome. *Section J* (Psychology): Prof. R. H. Wheeler, University of Kansas, United States. *Section K* (Botany): Dr. G. E. du Rietz, University of Uppsala, Sweden. Prof. Oswald Veblen, of Princeton University, is attending as the delegate of the American Association for the Advancement of Science, while Prof. D. A. Keys will represent the Royal Society of Canada. The South African Association for the Advancement of Science will be represented by Prof. J. E. Duerden.

Baron von Zach, 1754–1832

AMONG the men of science who fell victims to the epidemic of cholera which raged in Paris a century ago were Sadi Carnot (NATURE, Aug. 20, p. 266), and the Hungarian astronomer, Franz Xaver, Baron von Zach, who died there on Sept. 2, 1832. Born at Pesth on June 4, 1754, von Zach served for some time in the Austrian army, and from 1783 until 1786 was tutor in London in the family of the Saxon Ambassador, John Maurice, Count of Brühl (1736–1809), who was himself an amateur astronomer. One outcome of von Zach's visit to England was the discovery by him, under a heap of rubbish in an old stable at Petworth Castle, Sussex, of some manuscripts of the seventeenth century mathematician, Thomas Harriott. In 1786 he entered the employ of Ernst II. of Saxe-Gotha, and five years later became director of the observatory on the Seeberg at Gotha, afterwards the scene of the labours of the famous Hansen. With Bode, Olbers and Schröter, von Zach did much to revive interest in astronomy in Germany, and the *Monatliche Correspondenz*, which he founded in 1800, is referred to by Miss Clerke as "the first really effective astronomical periodical". He edited both this and other astronomical and geographical journals, and he was largely instrumental in stimulating German astronomers to search for a planet between Mars and Jupiter, a search which resulted in the discovery of the asteroids. The first of these, Ceres, was found by Piazzi at Palermo, but the second, Pallas, was discovered by Olbers at Bremen, while the third and fourth were likewise seen first by the German astronomers. Von Zach was also known as a teacher of astronomy. In 1804 he became grand-marshal of the palace of the duchess-dowager of Gotha, and after her death in 1827 lived for some years at Berne.

Application of Science to Economic Problems

THE recognition of the profound change in the whole structure of our civilisation, in its international relations as well as in the nature of production, is an essential condition for the elaboration of measures of recovery. The pamphlet recently issued under the title "Whither Britain: A Radical Answer" (London: Faber and Faber, Ltd., 1*s*.), and out[illegible]

some extent policies in development of those suggested in "Britain's Industrial Future" four years ago, frankly recognises these changes and accepts the necessity of adapting the structure and policies of society to meet the problems which arise. The authors of these papers have no quarrel with science as such, but rather recognise that science must play an important part in the planning and reconstruction which are essential for the continuance of our civilisation—that indeed modern science rightly applied could raise the standard of living to heights previously unknown and supply the material resources for a more abundant life for all. This is evident in their emphasis on science as a first major factor in agricultural policy, and their conviction that development of scientific research, its application to farming and improved marketing, are essential to the future prosperity of British agriculture.

The value of international industrial agreements is recognised, while imperial industrial agreements including imperial research are suggested as a line of promising development. While repudiating a policy of tariffs, this Liberal group advocates a system of national planned development comprising a national industrial commission with industrial and agricultural councils not unlike the Industrial Parliament visualised by Capt. Harold Macmillan in his scheme of creative protection. They argue further, however, that the State should also foster industry by keeping the demands for its products at a high economic level through well-planned social service and a constructive policy of national development. The perils presented by economic nationalism are not overlooked, and a paper on the international framework surveys the various problems such as disarmament, minorities, treaty revision, war debts, population, and migration, in which international co-operation and understanding are essential if progress is to be made. Even those scientific workers who, on the question of tariffs, differ most widely from the authors of these papers, should find much that is interesting and stimulating in their frank and virile statement of policy in the light of the actual facts of the present situation.

World-wide Telephony

At the International Electrical Congress recently held in Paris, several important papers were read on telephony. B. Gherardi and F. B. Jewett discussed 'world telephony'. The history of the subject illustrates how great discoveries occur at various intervals of time. Each of them causes a revolution in practice and between the intervals the process of applying the new inventions goes on continuously in the economic field. Such epoch-making discoveries were the invention of the thermionic tube, the permalloy series of nickel-iron alloys, and the discovery of paragutta. The use of paragutta has reduced the transmission losses to one-thirtieth of their former value. Many difficulties remain for engineers to overcome. For telephony between North America and Europe, 'long' radio waves are most suitable, but there is the fundamental restriction that there are only twenty 'ways' available owing to the limited breadth of the band of frequencies that can be utilised. With 'short' wave-lengths, the best wave-length to use depends on the hour of the day and the season of the year. Hence three wave-lengths are usually assigned to each circuit, and this limits the number of ways. Short-wave transmission is still in the first stage of its evolution; interruptions due to the vanishing of signals and to magnetic storms occur not infrequently, especially when the waves go through polar regions. The difference in local time between many large towns is a great inconvenience. There may be no overlapping in time between their working days. The language difficulty, although of less importance, is still a hindrance to progress. Many conversations are held between speakers in a language which neither knows well. In this case it is necessary that the clarity of the transmission be much better than when each is speaking his own tongue. Technical progress has now made possible communication between countries and continents. Whether this will be a boon to humanity or not depends on the nature of these communications.

Prof. Piccard's Ascent into the Stratosphere

On Aug. 10, Prof. A. Piccard, of the University of Brussels, accompanied by M. Max Cosyns, ascended at about 5 A.M. from Dubendorf Aerodrome, near Zurich, in a specially constructed balloon. He rose to a height of 16,700 metres (about 10½ miles), thus penetrating well into the stratosphere, and, after a twelve hours' flight, landed at Cavallaro di Monzambano, which is about ten miles south of Lake Garda. Among the equipment of the balloon was a wireless set, by means of which Prof. Piccard sent messages to surface observers. It will be recalled that this was Prof. Piccard's second ascent, his first having been on May 27, 1931, when he reached a height of 9¾ miles. As was to be expected, the aeronauts suffered considerable discomfort. The greatest trouble was the intense cold encountered in the stratosphere. Prof. Piccard states that he has made a number of observations which he hopes will prove of great value, but of any scientific results it is too early to speak. During his previous flight, Prof. Piccard had hoped to obtain evidence of the cosmic rays under more favourable conditions, and any contributions that he may be able to make in this field, from this flight, will be awaited with interest. Meteorologists look forward to the announcement of Prof. Piccard's results, especially if he has been able to make any observations on the composition of the atmosphere within the stratosphere; for, in spite of the observations already made by self-recording instruments on unmanned balloons, very little is actually known at present about this region.

Trans-Atlantic Flight from East to West

After waiting for some days at Portmarnock Strand, Co. Dublin, for suitable weather conditions, Mr. J. A. Mollison started on Aug. 18 at 11.30 A.M. on a solo flight across the Atlantic. His original intention was to strike the coast of North America, fly on to New York, and, after a short rest, to fly back across the Atlantic, thus making a round trip in about

three days. After thirty hours of flying, Mr. Mollison landed successfully at Pennfield Ridge, New Brunswick; it appears that he had sufficient fuel to go on, but was obliged by fatigue to come down. He was flying a Puss Moth aeroplane with a 120 h.p. Gipsy engine, such as is supplied to private owners, with the exception that the passenger seat has been replaced by petrol tanks. It is stated in the *Daily Mirror* that the direct costs of the flight were only £10 6*s*. 3*d*. for petrol and 15*s*. for oil. Mr. Mollison is the first to cross the Atlantic from east to west in a solo machine, which, incidentally, is the smallest to accomplish the crossing. The flight is a noteworthy tribute to the endurance of both man and machine.

Late Bronze Age Settlement in Shetland

A LATE bronze age settlement of considerable extent has been brought to light by excavation under the Office of Works at Sumburgh, at the southern end of the Shetlands. Previous excavation had revealed an iron age site, dating from about the beginning of the Christian era. During the present season, according to a correspondent in the *Times* of Aug. 19, six weeks' excavation has completely cleared one dwelling, partially cleared two more, and indicated the existence of others. The completely excavated dwelling shows evidence of four occupations, of which the third, as is shown by broken clay moulds, was much taken up with bronze-casting. It is 31 ft. in length, has an original and a secondary entrance, and three chambers with four lesser chambers opening out of them. The walls are three feet high and are built of selected pebbles from the shore, neatly fitted and without filling, except in the lower courses, where clay has been used to keep out the damp. Slate was much in use for tools. Both slate and stone implements show types not in use on the mainland. Of the partially excavated houses, the walls of one pass under those of the excavated house, and are therefore older. Slate was in use here. Though pottery is scarce, the ornament on one sherd gives a bronze age date. The second partially excavated dwelling is older again; but a sword and pottery of the type of Heathery Burn Cave, Co. Durham, still point to the late bronze age. Although the full extent of the settlement is not yet revealed, the existence of several other dwellings has been noted. When excavation is complete, the settlement will probably prove the most elaborate in plan of any known bronze age dwelling-place in Britain.

Roman Villa at Southwick

IT is announced that the Roman villa at Southwick has been given to the Sussex Archæological Trust with the object of ensuring its preservation. The villa is one of a chain of Romano-British buildings, probably farms, on a four-mile belt of fertile land south of the Downs, the others being at Kingston, Portslade, West Blatchington, and Brighton. The site has been excavated by Mr. S. E. Winbolt and others, with the aid of the Sussex Archæological Society. It was found to consist of a triangular block of buildings enclosing a courtyard approximately 200 ft. by 130 ft. The chief rooms are on the north side, where they are protected from the wind by the Downs; while verandahs on the sunny side face the sea. The buildings are solidly constructed, with walls 2 ft. and 3 ft. thick, and consist of rubble cores faced with flint. The site is at present unfenced; but as soon as funds have been raised, the northern portion containing the main buildings, which unfortunately is separated from the southern by the new road, will be fenced and reconditioned to enable the public to be admitted at a small fee. The Trust, to which the site has been handed over, was formed in connexion with the Sussex Archæological Society for the preservation of the ancient monuments of Sussex, and already holds in trust Lewes Castle, Wilmington Priory, the Long Man of Wilmington, the Marlipins at Shoreham, and Oldland Mill at Keymer.

Earliest known Pueblo Dating

DR. FRANK H. ROBERTS, Jr., who is in charge of an expedition of the Bureau of American Ethnology excavating Pueblo settlements on a site near Allentown, Arizona, is reported by Science Service, of Washington, D.C., to have obtained from one of the houses he has excavated beams which, according to the tree-ring chronology, were cut in the year A.D. 797. This is the oldest date for which evidence has been found in Pueblo ruins in the south-western United States. The dwelling was a pit-house, built largely underground, with an entrance through the roof. It had been destroyed by fire, the inhabitants leaving most of their belongings behind them, including much pottery. The oldest dates previously established by means of the tree-ring calendar elaborated by Prof. Douglass were A.D. 919 from a beam at Pueblo Bonito, and A.D. 861 from a piece of timber at Una Vida. Both these sites are situated in New Mexico.

Electric Tramcar Systems

ABOUT the beginning of the present century many local authorities undertook the installation of electric tramway systems in cities and towns, and many workers reaped the benefit of this system of transport. The coming of the petrol bus has led many to think that in a few years' time tramways will disappear. Their immobility often causes tramway congestion, and intending passengers have to cross a stream of traffic in order to board them, unless this stream be temporarily arrested. When one sees the great part played by tramcars in cities like London, Glasgow, and Manchester, and in many cities abroad, where tramcars with two or three trailers attached are continually going through crowded streets, it is obvious that it will be many years before they are obsolete. The large number of tramcars in Austria which were installed more than twenty years ago on the supposition that vehicles would always drive on the left-hand side of the road has led to difficulties in certain districts where one must now drive on the right-hand side. The cost of obtaining uniformity by altering the tramway lines in Austria is prohibitive at the present time. Just as in the case of weights and measures, what has been done in the past

difficult and expensive to introduce uniformity in the future, no matter how desirable proposed changes are. The advent of the trolley bus, which is much more mobile than a tramcar, will doubtless be a great help in the many years which will have to elapse before tramways become obsolete. Their popularity in Great Britain is due partly to the fact that, like electric tramways, they get their power from stations which burn coal obtained at home and not a foreign product like petrol.

Radio Equipment for Deep Sea Trawlers

FEW realise what a great boon radio equipment is to deep sea trawlers. Some of these small vessels fish at all times of the year on fishing grounds many hundreds of miles away from their home ports. Trawlers from Hull and Grimsby regularly fish off Bear Island near Spitsbergen; others trawl in the Davis Straits, 2400 miles from their base, and some off Iceland and in the White Sea. During the winter, which is the best fishing season, it is nearly always dark, and the gales and the intense cold make the work very hazardous. Catches vary considerably and the markets are sometimes glutted and sometimes short of supplies. It is of the greatest importance that the trawlers of the same company should be in close touch with one another, and this they can do by radio telegraphy. In the Engineering Supplement to *Siemens' Magazine* for March a discription is given of a radio station for use on board trawlers. The whole of the apparatus is contained in a teak case which can easily be passed through hatchways of normal size. This can be fitted into quite a small cabin or even into a cupboard. It receives and sends messages on wave-lengths between 20 and 20,000 metres, the required electricity being obtained from primary batteries and a small alternator. The output of the alternator does not exceed 300 watts, but the range with coast stations is often of the order of 1000 miles. In addition, Messrs. Siemens have designed a 'direction finder' which is simple to operate. Many trawlers also have a Marconi depth finder so as to enable them to locate the places where the required fish are likely to be found. Recent inventions have made the life of the trawlerman much easier and much more secure.

A High Voltage Electrostatic Generator

IN the August number of the *Scientific American*, there is a short account of the new electrostatic generator which is being built by R. J. van de Graaff at the Massachusetts Institute of Technology. From this and some notes which have appeared elsewhere, it seems that it is a large-scale elaboration of the Wimshurst type of machine, consuming considerable power in its operation. The discs of the Wimshurst machine are replaced by silk belts, and the separation of charges made regenerative. The charges are collected on enormous metal spheres, sufficiently large to hold an experimenter and apparatus, and capable of being charged to 10-15 million volts without flashover. Details of the power available for such experiments as those of Cockroft and Walton of the Cavendish Laboratory, Cambridge, are not given, but it is to be presumed that calculations have been made on the basis of Gamow's theories of the artificial disintegration of nuclei which justify the undertaking. The return to Faraday's device of sitting within highly charged apparatus is interesting.

Night-Crowing of Cockerels

A COMMUNICATION by D. Sinitsin on the night-crowing of the cock, published in Russian in 1924, in the Records of the Bielorussian Institute of Agriculture, attracted the attention of the late M. Bigourdan, the veteran French astronomer. Shortly before M. Bigourdan's death, Mr. Sinitsin provided him with full information on the subject. Mr. Sinitsin (1750 Wilton Place, Hollywood, California) has now sent to the Editor a record, illustrated by a diagram, of the fourteen nights' crowings of a cock kept in his study at Minsk, Russia, in 1923. Regular crowings occurred between 11 P.M. and 5 A.M., when they could be measured by hours, each crowing coming within ten minutes of the hour; before 11 P.M. there was no crowing, and after 5 A.M. it was not regular. Changes of atmospheric pressure, music, light, and talking in the room did not affect the regularity. The second and third crowings, especially when at 2 and 4 A.M., were the most vigorous and accompanied by flapping. It is suggested that the paroxysms of crowing are caused by something in the atmosphere perceived by the cock in some unknown fashion, and that it is connected with the rotation of the globe, waves from the sun-lighted side of this spreading to the darkened side. It is also put forward that the twelve-system of time-reckoning had its origin from the period when time could only be measured at night by cock-crowing, and that by artificial selection a race of cocks might be produced which would tell the time with clock-like regularity.

Meteorology of the Past, Present, and Future

SIR NAPIER SHAW (*Scientia*, June 1932) characterises the meteorology of yesterday by the accumulation of climatological data, their discussion in connexion with the general circulation of the atmosphere, and their analysis by the methods of harmonic analysis and coefficients of correlation. He emphasises the past concentration of attention on depressions and anticyclones, and the doubts which arise in connexion with reduction of pressures to mean sea level. The meteorology of to-day is essentially concerned with the interactions of air currents of different origin at the surface of separation which is known as the 'polar front', the methods of discussion being associated with the Norwegian school of meteorologists. The meteorology of to-morrow is, in Sir Napier's opinion, to concern itself with entropy as the specification of the qualification of any mass of air for its position. The name 'weather potential' is suggested as another name for entropy. Sir Napier suggests that all motion in the atmosphere, apart from penetrative convection, is along isentropic surfaces, so that these surfaces act as automatic guides to all moving air, in much the same sense that the banks of a river act as automatic guides to the water in the river. He also suggests, though very briefly, that regions of high and low pres-

sure in the atmosphere are created by currents of air associated with straight isobars, in which the velocity is not of the right amount to produce a balance between pressure gradient and the deviating force due to the earth's rotation, and that the effect of gravitational forces on masses of air, the entropy of which differs from that of their environment, can develop a column of low pressure.

The People's Cinema University

A leading recommendation of the Commission on Educational and Cultural Films which was set up in 1929 was the establishment of a National Film Institute (see Nature for June 18, p. 911). One is interested, therefore to observe the scheme evolved by Sir James Marchant and Sir Oswald Stoll for the establishment in London of the People's Cinema University. The university, it is stated, would consist of a central building, from which lecture halls equipped with sound-film installations for the regular exhibition of films would radiate. In the central dome there would be a Zeiss planetarium. There would also be reading rooms, offices, etc., available for film patrons and societies. All these features are combined in an imposing general design prepared by Sir Giles Gilbert Scott. The films would be made in co-operation with an expert educational board to meet the requirements of teachers and scholars, and would be distributed and collected by motor cinema vans throughout the country. Projectors also would be supplied to schools, churches, and institutions. In his broadcast address and in letters to the *Times*, Sir James has directed attention to useful educational work already accomplished. The catalogues issued by Visual Education, Ltd., indeed, list quite an impressive series of educational and cultural films. Sir James believes, therefore, that the time is ripe for such a venture as the People's Cinema University, which, in its own sphere, would attempt work resembling that of the B.B.C.

Change in Colour of Birds due to Exposure

Mr. P. J. Norman, in *Cage Birds* for Aug. 6 (p. 70), cites a remarkable case in which a black-headed variety of the budgerigar, after being turned out into an outdoor aviary provided with a 'flight' or net-roofed annexe, so that the birds were exposed to rain if they wished it, has resumed the normal yellow colouring of the head. The breeder of this bird, it seems, has stated that all of its nest-fellows were also black-headed, and that these had retained the black head through a moult. The family had been bred indoors, in a cage, and it is suggested that in the case of the bird which reverted, the exposure to open air and rain in its new quarters had brought about the return to normal plumage. It would, however, be well worth while to see whether outdoor treatment would operate in this way with the rest of the brood; or, if they be still kept indoors, whether they will produce black-headed young. It may be noted here that of the first two specimens of the rare East Asiatic Derbyan parrakeet the London Zoological Society possessed, one became black-headed and afterwards reverted to normal, while its companion did not change, though both lived in the same cage indoors in the old Parrot House.

Helminthological Abstracts

One of the first fruits of the various agricultural bureaux formed by the Imperial Agricultural Research Conference has been the establishment of a number of abstracting journals, the latest of which to appear being *Helminthological Abstracts*, under the editorship of Prof. R. T. Leiper. This new journal, which is issued as a supplement to the *Journal of Helminthology*, differs in several important respects from the others. Papers are arranged by journals, not by subjects, and each abstract is printed so that the first sentence is in effect an extended title; the remainder is a succinct abstract of the chief results obtained by the authors. The *Abstracts* will be issued in five parts each year, the first of these being in April. This will enable a single volume to cover the entire literature for the calendar year, so that, in addition to keeping the current literature before the reader, it will when bound form a complete summary of the year's work. It is priced at 16*s*. 6*d*. a volume, post paid, and is obtainable from the Institute of Agricultural Parasitology, St. Albans. Another publication from the same Bureau is the "Bibliography of Helminthology" for the year 1930 (6*s*.). This volume contains references to more than 900 titles in 346 different journals. These titles are arranged by journals, with an adequate authors' index. The volume has the same format as the *Abstracts*, and although issued separately could be bound with the completed volumes to form an invaluable index to the journals abstracted and the authors of the papers.

Prof. Richard Willstätter

Die Naturwissenschaften for Aug. 12 is a special issue in honour of Prof. Richard Willstätter's sixtieth birthday. The memoir contains a series of articles by experts upon the fruitful results of his memorable researches in organic chemistry. Prof. F. Haber refers to the successful campaigns which Willstätter has conducted in different branches of biochemistry, for the exceptional skill which he displayed in elucidating chemical structures was principally concentrated upon problems closely related to living matter. Prof. Pummerer reviews the results of forty years of strenuous endeavour. First comes a masterly series of papers upon alkaloids, culminating in the synthesis of tropin and cocaine; then for a while aromatic structures claim attention, particularly quinone-imines, aniline black, and cyclo-octa-tetraene. But Willstätter's interest in plant life led him to the study of the compounds to which plants owe their distinctive colours. Thus chlorophyll, carotene, and the anthocyanins were investigated in turn, and the success attained in each of these branches led him to the further problem of assimilation by plants. This involved the study of enzymes, which has yielded some astonishing results in recent years. Prof. L. Zechmeister describes the main lines of Willstätter's work on carotinoids and the important hydro[illegible] carotene, which has come into prominence [illegible]

of its relation to chlorophyll and to vitamins. Prof. R. Robinson discusses in some detail the structures of anthocyanins, the red and blue colouring matter of flowers. Prof. R. Kuhn refers to the influence of Willstätter's work on the development of the theory of heteropolar rings, and Dr. Waldschmidt-Leitz describes the process of resolution of enzyme mixtures from the pancreas and from yeast by a method of selective adsorption. The concluding article upon chlorophyll and its derivatives is by Prof. A. Stoll and Dr. E. Wiedemann.

A New Periodical for Chemical Physics

As a part of its comprehensive programme of physics publications, the recently formed American Institute of Physics (see NATURE for Aug. 6, p. 199) announces that it will shortly begin a new publication to be called the *Journal of Chemical Physics*. The first number will be issued in January 1933. Primary among the circumstances which have led the Institute to undertake the new publication is the increasing number of articles on physical chemistry which have distinct bias on the physical side. These have not found a suitable outlet in any journal now in existence, being perhaps too mathematical for the *Journal of Physical Chemistry*, too physical for the *Journal of the American Chemical Society*, or too chemical for the *Physical Review*. Inquiries or suggestions concerning the new journal should be addressed either to Dr. Harold C. Urey, Department of Chemistry, Columbia University, or to the American Institute of Physics, 11 East 38th Street, New York.

Irrigation in India

THE progress of irrigation and the use of the available water are surveyed in the "Triennial Review of Irrigation in India, 1927–30" (Simla: Government Press, 2*s*. 6*d*.). It would appear that the monsoon of 1927 was almost normal in its time and rainfall except for a slight deficit. In 1928 there was a marked deficiency in the north-west, and in 1929 the principal departure from the average was an excess of 100 per cent in the rainfall of the North-West Province and Sind. During the three years under review, the average area irrigated by Government works in British India was 29,954,000 acres, an advance of more than two million acres on the corresponding figure for the previous triennium. The chief increase was in the Punjab valley, owing to the development on the Sutlej valley canals. It is noticeable that, of the total sown area, 12·7 per cent was irrigated. Among the most important projects now in hand are the Sukkur Barrage and canals in Sind, the Sarda canal and a hydro-electric power scheme on the Ganges canal in the United Provinces, and the Sutlej valley project in the Punjab. The problems of water supply in Baluchistan are being considered in the hope of improving the very poor irrigation facilities.

Commonwealth of Australia Yearbook

THE Yearbook of the Commonwealth of Australia contains a mass of descriptive and statistical which much is of considerable scientific value. The prevalent demand for economy has curtailed to some extent the size of the volume, but there is little evidence of its usefulness being impaired. The figures dealing with agricultural production are particularly full, vital statistics are given much space, and there is a long article, accompanied by distributional maps, on the climate and meteorology of Australia.

Announcements

PROF. R. RUGGLES GATES will deliver three De Lamar lectures at the Johns Hopkins University during the week beginning Oct. 24, on "The Principles of Heredity in Man, and their Application to Society".

IT is announced in *Science* that Prof. Rudolph W. Ladenburg, of the Kaiser Wilhelm Institut für physikalische Chemie und Elektrochemie, has been appointed to the Cyrus Fogg Brackett research professorship at Princeton University, in physics.

THE Society for Cultural Relations with Soviet Russia is considering the possibility of arranging a tour of scientific institutions in Russia, to leave London on Sept. 10. It is proposed to arrange for parties of British scientific workers engaged in physical, biological, and medical research, and for engineers, chemists, and anthropologists, to visit the corresponding institutions in Russia, and to meet Russian workers engaged in similar research. The total cost of the tour is about £35 inclusive, the time being approximately one month from departure to return to London. Further particulars and application forms may be obtained from the Secretary, S.C.R., 1 Montague Street, London, W.C.1.

MESSRS. W. and G. Foyle, Ltd., of 119-125 Charing Cross Road, W.C.2, have recently published a new catalogue of new and second-hand books on technical subjects and applied sciences. More than 450 subjects are represented. About three thousand books are catalogued, and the list should prove a source of help. The majority of the standard works are available, many of them being obtainable second-hand as well as new.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A headmaster for the Netherton Farm School, near Morpeth, Northumberland—The Secretary, 18 City Road, Newcastle-on-Tyne (Sept. 3). An assistant conservator of forests in the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (Sept. 5). A professor of zoology at the University of Bristol—The Secretary and Registrar (Oct. 1). A resident tutor of chemistry, rural science, and school hygiene at the Winchester Diocesan Training College—The Principal. A headmaster of the Incorporated Thames Nautical Training College, H.M.S. *Worcester*—The Secretary, Ingress Abbey, Greenhithe, Kent. An assistant (woman), with analytical experience in organic and inorganic work, at the Air Ministry, Kidbrooke—The Secretary, (I.G.), Air Ministry, W.C.2.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A Correlation of the Walden Inversion with the Pinacone and Beckmann Changes

THE esterification of an alcohol may be represented as involving decomposition of an oxonium salt (I.), which corresponds closely to a reaction of quaternary ammonium hydroxides (II.):

$$\bar{A} + \begin{matrix} X \\ Y \\ Z \end{matrix}\!\!>\!C\,.\,\overset{+}{O}H_2 \longrightarrow A\!-\!C\!\!<\!\!\begin{matrix} X \\ Y \\ Z \end{matrix} + H_2O\,;$$

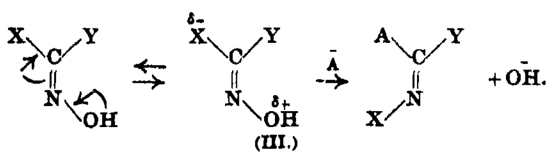
(I.)

$$\bar{O}H + \begin{matrix} X \\ Y \\ Z \end{matrix}\!\!>\!C\,.\,\overset{+}{N}Me_3 \longrightarrow HO\,.\,C\!\!<\!\!\begin{matrix} X \\ Y \\ Z \end{matrix} + NMe_3.$$

(II.)

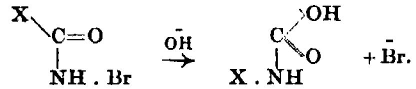
These reactions very possibly proceed by extrusion of a molecule of water or tertiary amine, consequent upon attachment of anion in virtue of a positive charge on the carbon atom derived from, or induced by, that on the oxygen or nitrogen.[1] It may, however, be anticipated that this latter rather than the derived charge will determine the result, and permit only a condition of electrovalence, when the direction of approach of the anion is such as to expose it to the operation of either. In other words, covalent union with carbon will be dependent on approach from the side of the molecule remote from oxygen or nitrogen, and inversion of configuration must occur. As Kenyon and Phillips[2] have emphasised, inversion in general is associated with reactions of the type now discussed, but it is clear that similar considerations are applicable to a negatively charged atom and a cation, and it is probably only on account of the difficulty of realising these latter conditions in practice that Walden inversions of this type have not been realised.

The relationship of the Beckmann change to the Walden inversion is indicated by the facility of each type of change in the cases of the *p*-toluene sulphonic esters of oximes and alcohols respectively. Since, now, the behaviour of the oximes towards substituting agents is comparable with that of phenol,[3] their isomerisation under the influence of strong acids may be attributed to formation of the system (III.):



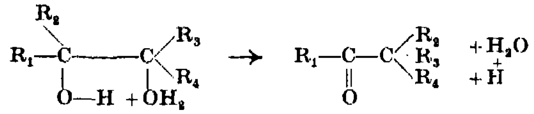
(III.)

The actual Beckmann change then represents an alternative possibility to the occurrence of depolarisation (by reversal of the initial change), which will be facilitated by the presence of a suitable anion to replace the migrating group X in its combination with the carbon atom. X in turn will promote detachment of hydroxyl or other ion from the nitrogen atoms. The analogy of this phase of the reaction to the changes referred to at the outset is obvious, and, accordingly, Meisenheimer's experiments[4] have led him to conclude that inversion occurs, in the sense that it is X rather than Y which migrates. Corroborative evidence in favour of this view is afforded by another reaction, which has long been connected with the Beckmann change, namely, the formation of amines from acid bromoamides and similar derivatives. The reaction is actuated by hydroxyl ions, and may thus reasonably be considered to be analogous in its first stage to the alkaline hydrolysis of esters,[5] involving extrusion of the group X with the pair of electrons requisite to enable it to preserve its configuration[6] and to displace bromide ion from the nitrogen atom:



As thus represented, the reaction is also not dissimilar from the benzilic acid change.

Like these, the pinacone and related changes also exhibit the characteristics requisite for an intramolecular Walden inversion, the negative change requisite for migration of the group R_2 arising from detachment of a proton from the hydroxyl group (or, in certain closely related changes, by attachment of an anion):



In this connexion, Kenyon and Phillips have already surmised that McKenzie's observations[7] on the preservation of optical activity in these types of changes, and in semipinacolinic deamination, are indicative of a Walden inversion.

J. KENNER.

College of Technology,
Manchester,
July 29.

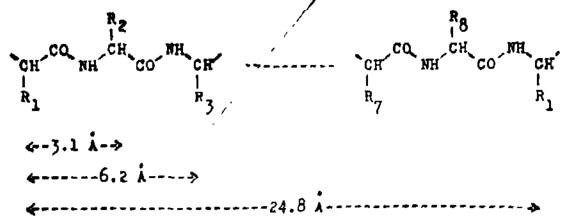
[1] Compare NATURE, **128**, 1000, Dec. 12, 1931.
[2] Compare *J.C.S.*, 415; 1930; 382; 1931; *Trans. Faraday Soc.*, **26**, 451; 1930.
[3] Charlton, Earl, Kenner, and Luciano, *J.C.S.*, 30; 1932.
[4] *Ber.*, **54** B, 3206; 1921.
[5] Compare Houben Weyl, "Methoden der organischen Chemie", 2nd ed., vol. 4, 339.
[6] Jones and Wallis, *J. Amer. Chem. Soc.*, **48**, 169; 1926.
[7] Compare, *inter alia*, *Ber.*, **62**, 272, 284; 1929.

X-Ray Interpretation of the Molecular Structure of Feather Keratin

SOME two years ago it was shown in this laboratory that the quill of a feather gives rise to a complex but well-defined X-ray fibre photograph[1] which is quite different from that of animal hairs.[2] It was afterwards shown that a similar photograph is given also by tortoise shell, and the conclusion was formed that it is characteristic of the keratin of feathers and reptilian scales as opposed to that of mammalian hairs, nails, horns, spines, etc.[3] In the light of knowledge gained from the X-ray analysis of other protein fibres, it is now possible to interpret the feather photograph and fit it into the general scheme which such investigations, with increasing clearness, are beginning to unfold.

The details of the photograph need not be gone into here, and indeed have not yet been worked out completely, but it is clear now that it is only a rather bewildering elaboration of the type of photograph which is obtained from natural silk (fibroin)[4] and the stretched form of hair (β-keratin),[5] both of which have been referred to a polypeptide chain in a more or less fully extended state. The side spacings are similar, but there are indications of some ten hyperbolæ in the feather photograph. By the application of the principle of 'layer line enhancement',[6] the may be separated into sets grouped round

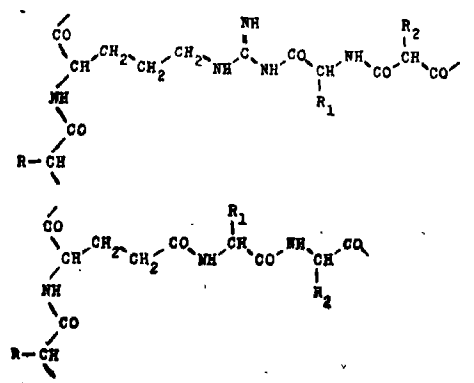
periodicity of (at least) 24·8 A., and secondary periodicities of 6·2 A. and 3·1 A., corresponding to the chain :



The last-mentioned spacing recalls the 3·5 A. found in fibroin and the 3·4 A. in β-keratin : we have shown that the difference is due to a slight folding of the peptide chain, analogous to that discovered in the unstretched form of hair (α-keratin),[3, 5] which must be due to a further inter- or intra-chain linkage of a resistant but non-rigid nature. We base this deduction on the striking observation that when the quill is stretched, its fibres are not ruptured until the spacings along the fibre axis have increased continuously by as much as 6 per cent. Stretching thus transforms the spacing, 3·1 A., associated with the length of a single amino-acid residue, into 3·3 A., which is only a little less than the value found in silk and stretched hair.

Interesting as is the molecular interpretation of feather keratin on its own account, its importance as a contribution to protein analysis in general is even greater, because of the powerful support it brings to the concept of the extensible protein chain. In view of the results here reported, any doubts as to the essential correctness of the conclusions to be drawn from the X-ray analysis of silk and animal hairs [4, 5] may now be set aside. The protein chain, as a long backbone of primary valencies decked out with numerous side-chains the interactions and cross-linkages of which can produce foldings of the main chain of widely varying amounts, may now be thought of as a definite stereochemical entity grown visible, like the cellulose chain and many other simpler molecules, in the light of the X-rays.

It is scarcely necessary to point out how many fascinating questions are involved in the comparative X-ray study of the molecular structure of hair and feathers, and in the significance of the sequence of eight side-chains in the longitudinal pattern of the latter. May it not be that the growth of feathers finds its origin in the development of further keratin chains by the formation of *lateral* peptide linkages ? From the side-chains of arginine and glutamic acid, for example, such outgrowths as the following are possible :



The investigations are being continued and will [...]ed in detail in due course. A complete chemical analysis of the type of feather under examination is also being undertaken in the Textile Chemical Laboratory.

W. T. Astbury.
Thora C. Marwick.

Textile Physics Laboratory,
The University, Leeds, July 12.

[1] See, for example, W. T. Astbury, "The Structure of Fibres", Annual Reports of the Chemical Society for 1931.
[2] W. T. Astbury and A. Street, *Phil. Trans. Roy. Soc.*, A, **230**, 75; 1931.
[3] T. C. Marwick, *J. Text. Sci.*, **4**, 31 ; 1931.
[4] R. Brill, *Annalen*, **434**, 204 ; 1923. K. H. Meyer and H. Mark, *Ber.*, **61**, 1932 ; 1928. O. Kratky, *Z. physik. Chem.*, B, **5**, 297 ; 1929 : **11**, 363 ; 1931.
[5] W. T. Astbury and H. J. Woods, Nature, **126**, 913 ; 1930. *J. Text. Inst.*, **23**, T17 ; 1932.
[6] W. T. Astbury, *Proc. Roy. Soc.*, A, **112**, 457 ; 1926. W. H. Bragg, Nature, **121**, 327 ; 1928. A. L. Patterson, *Z. Krist.*, **76**, 182 ; 1930.

J. W. Gregory

"Drowned by the capsizing of his canoe on the Urubamba." Thus has passed Prof. J. W. Gregory, at the age of sixty-eight years, continuing to the last his brilliant career of tireless exploration. British geology has lost one of its most intrepid leaders, and his fellow scientific workers the world over will miss his stimulating thought.

It is not my privilege to review the varied aspects of his life as administrator, teacher, explorer, and man of science. Although known to me through his observations in Africa, Australia, and Chinese Tibet, he remained an impersonal thinker among my colleagues until we had both passed three score and more. I first met him in his home at Glasgow when on my way to Africa to study the rift valleys, his own special subject.

We were then mutually aware of pronounced differences of opinion on theoretical questions, but the frank, cordial reception accorded me disarmed for all time any instinct of intellectual antagonism and quickly established happy relations. In long and earnest discussions, I found him a well-informed and aggressive opponent, strongly convinced of the essential soundness of the geological philosophy of Eduard Suess. His convictions were natural. In the fluid medium of speculation, where free-swimming facts may group themselves at will, ideas take forms determined by bent of mind and circumstance. The agreement between thinkers so unlike as Suess and Gregory illustrates the effect.

In Gregory's youth, Suess was already the master philosopher of European geology. Certain racial characteristics distinguished the younger from the older man, but there was between them an intellectual link in that both used their great powers of imagination creatively.

Suess was the embodiment of German *Gemütlichkeit*. He loved his home above all else. He had voluntarily become sessile, early in life. His scientific thought was contemplative. He read, absorbed, and moulded the observations of others to create the *Antlitz* of the world of his imagining. Gregory, by contrast, was intensely active. His habit of observation was objective. He travelled far and wide to accumulate facts. But he also possessed a creative imagination that was strong of wing.

While still a daring, enthusiastic youth (in fact he was never any other, where danger was concerned) Gregory explored the Great Rift Valley of East Africa and found it to be a tension rift. Suess, on the evidence of more casual descriptions, had conceived it to be part of a great rent, 4000 miles long, torn through Africa and Arabia by the subsidence of that part of the suppositional Gondwana continent which occupied the site of the Indian Ocean. Here was an agreement

of observation on the part of Gregory with the inference on the part of Suess, which could not but be convincing. The grandeur of the concepts appealed to Gregory's poetic thought, and he became for life an advocate of Suess's ideas of the development of the Indian Ocean basin by the foundering of Gondwanaland.

It is well known that weighty arguments in support of the general theory of lost continents may be adduced from palæontology, from the geological histories of Africa, Asia, and the Americas, as also from climatic changes throughout geological time. Gregory was master of them all. The scope of his knowledge was all-embracing. An eager student, a bold investigator, a rapid thinker, endowed with a capacious memory for facts and constructive capacity for synthesis, he became, as the result of his far-flung explorations, an outstanding authority on the world as a whole.

Gregory was, however, far from being a dogmatic theorist. Though tenacious and formidable in argument, he recognised the incompleteness of geological evidence and appreciated the obligation to consider advances in knowledge. In 1915 he wrote in " Geology of To-day " :

" In order to free geology from hopeless attempts to solve problems which could not be solved with the knowledge then available, and to get rid of the incubus of unscientific and premature hypotheses, a group of English geologists founded the Geological Society of London."

To that purpose he was loyal. In the words of Lyell, he conceived the ideal of the founders to have been " to multiply and record observations ", and to that end he dared every risk and devoted his life unsparingly.

Gregory passed, as he would have wished, in active service. He leaves a most eminent name in the roster of great British geologists, but it cannot fill the emptiness in the hearts of his friends.

BAILEY WILLIS.

Stanford University,
California.

Appearance of a Rusty-Red Pigmentation in the Coats of Albino Rats in the Tropics

SOME details of the appearance of a reddish pigmentation in the coats of certain rats after importation into Trinidad from London may be of interest to geneticists.

The colony lies between ten and eleven degrees north of the equator. The shade temperature during the day ranges from 85° to 95°. The night temperature is somewhat lower, especially in the dry season from December to March or April, when the lowest temperature is about 70°. The health of the rats was good. They arrived at the laboratory in November and December 1928. Forty-five were pink-eyed albinos, seven males and thirty-eight females; four were black-and-white, two males and two females, with the Dutch-rabbit distribution of pigment: these were all black-eyed. They were placed in roomy cages, four females to each male. No attempt was made to isolate the albinos from the black-and-white in the matings, as genetic experiments were no part of my programme. No alien blood of any kind was introduced. The only selection made was that animals varying in weight more than ten per cent above or below the average of their litter mates were discarded as unsuited for dietetic experiments.

The following notes were recorded :

January 1929; the albino offspring ($F1$) of the imported animals were of a creamy-yellow tint.

April 1929; second generation ($F2$) born. Some of the ratlings were reddish-yellow.

September 1929
marked in many of
in metabolism seemed t
persisted, and some of th
the Dutch marking in pal
Black-and-whites still appea
proportion.

December 1929; some of th
rusty-red tint, like an English ha

August and September 1931;
coloration of the animals employed
months were :

All rusty-red, of various shades, or all yellow	
Rusty-red-(or yellow)-and-white .	1[illegible]
Black-and-white (Dutch-marked) .	4
Black with white belly . . .	4
Total	80 rats.

A reddish strain of fancy rats similar to those described above and, like them, possessing pink eyes, is known to animal fanciers. These originated in Japan, coming, it is said, from Nagasaki, a place with a rather hot climate.

In May 1932, Dr. Wise, Surgeon-General of Trinidad, sent me some of the Trinidad red rats, descendants of those I had left there. These seem darker than those I saw last September. The eyes remain pink, and their bellies, though reddish, are lighter than the rest of the body. Four of this contingent are in a tropical house at Kew for breeding experiments.

On March 3, 1932, a male and two female albino Wistar rats from the Medical Research Council were sent to the same house to ascertain whether results similar to those found in Trinidad would be obtained. The conditions as to temperature and humidity are almost identical with those of Trinidad, the chief difference being the lesser amount of sunlight.

In a few weeks these rats showed a slight creaminess of tint, which was especially marked on the back of the neck.

Litters ($F1$) were born in March. These were all cream-coloured, in varying degrees of intensity. One male and two females of these were retained at Kew for breeding, the remainder being taken to the animal house at the London School of Hygiene and Tropical Medicine. In June, litters ($F2$) were born, these being distinctly darker than their parents. The Kew-bred rats grew darker in colour both when retained in the tropical house and when brought to the School, but this latter result may be partly due to the fact that the end of June and the beginning of July were hot.

In addition to these facts, and possibly standing in some causal relationship with them, is the occurrence of extensive gastro-intestinal hæmorrhage in rats living in Trinidad or in a tropical house at Kew, when given for a few days a diet of water only. A few animals on this diet in the temperate climate showed traces of bleeding, but not more than traces, whereas in the tropical climate the appearance of the intestines resembles red-currant jelly.

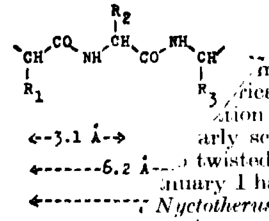
ALFRED CLARK.

London School of Hygiene and
Tropical Medicine,
Keppel Street, London, W.C.1, Aug. 2.

Cytoplasmic Inclusions of *Opalina* and *Nyctotherus*

A VERY interesting paper has recently appeared by Richardson and Horning,[1] on the cytoplasmic structure of *Protopalina* and *Nyctotherus cordiformis*. In the opalinids these authors distinguish three classes of inclusions: first, darkly staining rod-like stru
the mitochondria, often in close connex

periodicity of (at least) 24·8 A ive granules, which
periodicities of 6·2 A. and 3·1 A in form; and thirdly,
the chain: n preparations by the
and Cajal—fairly large
wisted and snake-like, and
he cytoplasm.
mitochondria[2] are numerous
rical structures, often showing a
tion; while the Golgi bodies are
arly scattered, and vary from rod-
twisted filaments.
nuary I have been working on *Opalina*
Nyctotherus cordiformis, both by means



The last eparations and *intra vitam* staining. In
in fibroi my silver preparations I find fairly large
that t ed bodies, more or less round in shape, near
pept ctoplasm but never in the central regions, and
twisted, snake-like in shape. These seem to be the same bodies as identified by Richardson and Horning as Golgi bodies; but I am not convinced that these bodies seen in my formalin silver material are the homologues of the Golgi bodies of Metazoa, both because of their dissimilarity to known types of Golgi apparatus and from failure to show them after many attempts with post-osmication methods (Lassanov, etc.). They may indeed be artefacts.

In chrome-osmium material I find both the rods and irregular bodies, but this also holds after many fixatives, even alcoholic ones; and also all gradations are found between these rods and irregular forms. Hence I have arrived at the conclusion that these are but two aspects of the same structure; they are not mitochondria, but are probably connected with the storage of food. The true mitochondria are small spherical granules, which stain *intra vitam* with Janus green, as well as being seen in chrome-osmium material.

In *Nyctotherus*, I have observed the same two categories of bodies as shown by Richardson and Horning; the larger (their Golgi elements), I have fixed with many methods (absolute alcohol, corrosive acetic, Flemming-without-acetic) as well as by silver techniques—slides, so made, were stained by Gram's method, and these bodies were proved to be Gram-positive bacteria, exactly like certain bacteria in the rectal contents. For this determination my thanks are due to Prof. Bigger of the Bacteriology Department, Trinity College, who carefully examined my slides. The smaller bodies, mitochondria of Richardson and Horning, were shown by similar fixatives and gave a Gram-positive reaction. It may be that they are mitochondria in which the protein base is particularly well developed, and hence they are not dissolved out by absolute alcohol.

It is hoped shortly to publish a full account of these observations.

RUTH PATTEN.
Department of Zoology,
Trinity College,
Dublin, July 13.

[1] *Amer. J. Morph. and Physiol.*, Sept. 1931.
[2] See also earlier papers of Horning.

Colonisation of the Sea by Insects

THOUGH insects are represented in almost every possible niche in terrestrial and fresh-water environment, very few indeed have colonised the sea. Besides *Halobates*, which is pelagic, only some chironomid larvæ and a trichopteron are known to be permanent inhabitants of the sea.[1] Many insects, however, can live in waters having a salinity equal to and even much higher than that of sea water.[2] This indicates that ...y is not a barrier to their migration, neither do ... currents and tides appear to be, since many insects live in torrential hill-streams which run with almost an equal, if not greater, force and velocity. Furthermore, many insects live on the sea shore[3] where the physical effects of tides are most pronounced.

In the autumn of 1930 and the spring of 1931, I made extensive collections in several salt waters of the Salt Range, Punjab. I obtained numerous specimens of insects from waters of a salinity 2·5 times as great as that of the sea. These insects included may-fly larvæ (*Claeon* sp.) and several hydrophilid beetles. The occurrence of may-fly larvæ in such highly saline waters is, I believe, recorded here for the first time.

A careful comparison of the detailed chemical analyses of waters from the Salt Range area with those of sea-water samples taken by the *Challenger* from different oceans of the world shows that the most important difference between the two is the comparatively low calcium content (1·16-1·20 per cent) of the sea water. In the salt waters investigated by me the percentage of calcium varied from 1·77 to 31·67, except in the San Sakesar Lake, where it was 0·11 per cent and in which no insect life was found. This definitely suggests that it is the low calcium content of sea water which has stood in the way of insects inhabiting the sea, and that it is the large amount of this ion in the waters of the Salt Range which helps insects in keeping their body fluids in equilibrium with the highly saline waters which they inhabit. This suggestion seems to be strongly supported by the work of Pantin,[4] Weil and Pantin,[5] and Pantin,[6] who in the case of estuarine animals showed that calcium has a profound influence on their permeability to water and salts. McCutcheon and Lucke [7] found similar factors operating in the case of *Arbacia*.

I am testing this hypothesis by means of experiments, and the results will be published in due course. My detailed studies on the fauna of some of the salt waters of the Salt Range, Punjab, will be published elsewhere.

HEM SINGH PRUTHI.
Zoological Survey of India,
Indian Museum,
Calcutta, July 20.

[1] Buxton, P. A., *Proc. Zool. Soc. Lond.*, 807; 1926.
[2] Balfour, A., *Bull. Ent. Res.*, **12**, 29; 1921.
[3] Flattely, F. W., and Walton, C. L., "The Biology of the Sea Shore", London, 1922.
[4] Pantin, C. F. A., *Brit. J. Exp. Biol.*, **8**, 63; 1931.
[5] Weil, E., and Pantin, C. F. A., *ibid.*, 73; 1931.
[6] Pantin, C. F. A., *ibid.*, 82; 1931.
[7] McCutcheon, M., and Lucke, B., *J. Gen. Physiol.*, **12**, 129; 1928.

Leaf-Curl in Cotton and Other Plants

IN a recent communication[1] Mr. Mathur gives an account of his observations on the leaf-curl in garden zinnias, caused by *Bemisia gossypiperda* Misra and Lamba, at Dehra Dun. The title of the letter suggests that the virus causing leaf-crinkle in cottons in the Sudan is the same that causes leaf-crinkle in zinnias at Dehra Dun. This certainly has not been established so far.

Leaf-crinkle or leaf-curl is not uncommon in cultivated plants. There are in the Punjab, occurring quite commonly, leaf-curls of potatoes, tomatoes, chillies, cucurbits, etc. In the Punjab, however, so far, no leaf-crinkle on cotton has been found associated with *B. gossypiperda*. Just now there is scarcely a cotton leaf which is free from white-fly infestation, yet leaf-crinkle is completely absent.

Leaf-crinkle in cotton should not be confused with leaf-crinkle in other plants without obtaining definite evidence that the same virus is responsible for the disease.

M. AFZAL HUSAIN.
Locust Research Laboratory,
Lyallpur, Punjab, July 16.

[1] NATURE, **129**, 797, May 28, 1932.

Some Characteristics of Ultimate Lines

1. *Classification and Exciting Potentials.*—The ultimate lines are classified as primary, secondary, or tertiary as suggested by Russell, modifying the nomenclature in the form proposed by Catalan and by us.[1]

The following table gives the number of ultimate lines for the different classes and the minimum and maximum values of their exciting potentials. Those computational data are based on the table of the author published in Twyman and Smith's book.[2] A complete list of the exciting potentials and other data for each element will be published shortly in the "Contribución al Estudio de las Ciencias, Serie Mat.-Fisica" (La Plata).

Classification.	Number of Lines.	Exciting Potentials.
Arc lines Primary .	277	0·0 to 1·32
,, Secondary .	206	0·28 to 5·45
,, Tertiary .	53	0·92 to 9·15
Spark lines Primary .	170	0·0 to 0·56
,, Secondary	109	0·14 to 11·90
,, Tertiary .	60	0·32 to 17·94
Not classified . .	204	?
Total number .	1079	

Fifty per cent of the ultimate arc lines correspond to the primary lines class, and the same proportion is maintained in the spark lines. According to Meggers, Kiess, and Walters, jr.,[3] all the ultimate lines of the spark, with no exception whatsoever, are originated in the fundamental levels; this conclusion is also maintained by Catalan.[4] Our computations do not support that assertion, which is only found true regarding very few elements of the iron group.

2. *Absorption.*—Supplementing our observations regarding the ultimate lines [5] we have established, as the extreme limit for the appearance of the ultimate lines in absorption, the value $N_1/N = 1/14{,}500$, that—according to the equation $N_1/N = e^{-\frac{E}{RT}}$, where N_1 is the number of the excited atoms and N the total number of atoms—corresponds to a value of $E = 1{\cdot}03$ volts for $T = 1250°$ and to a value of $E = 2{\cdot}06$ for $T = 2500°$.

The value $N_1/N = 1/14{,}500$, adopted by us, corresponds to an extreme limit because, according to our experimental data,[6] faint absorption lines only are observed for $N_1/N \geqslant 1/1600$ and lines of medium intensity for $N_1/N \geqslant 1/210$; for the value adopted, only lines of absorption of a very faint intensity and few in number are observed. In accordance with the preceding considerations, and not taking into account other factors in the obtaining of the absorption spectra—the most important of which is the vapour tension of the element considered—it is possible to observe, in an absorption at a temperature of 1250°, those lines the original levels of which are the fundamental ones that are separated from it by not more than 1·03 volts; that is to say, 330 lines out of 536, and, at a temperature of 2500°, 414 lines out of 536. The quantities given are maxima, because if we consider the possible number of lines of absorption of medium intensity, the value N_1/N should be 1/210, corresponding to a value of 1·13 volts at 2500°, which shows that—excluding the lines originated at the fundamental levels—only a small number of those corresponding to other levels may be observed in absorption.

3. *Multiplets.*—In the case of multiplets, the ultimate lines fulfil the conditions $\Delta l = 1$ for $\Delta j = 1$ and 0, and $\Delta l = 0$ for $\Delta j = -1$ and 0. The only exceptions to this rule are the multiplets *SP* (Mn, Cr, etc.). This conclusion is identical with the one we established [7] regarding the lines t. fulfil the same con quantum numbers.

Instituto de F
Universidad de La Plat.
June 19.

[1] Twyman and Smith, "Wavelength T. p. 137.
[2] Op. cit., p. 135.
[3] *J.O.S.A.*, **9**, 355; 1924.
[4] *An. Soc. Esp. Fis. y Quim.*, **28**, 92; 1930.
[5] *Cont. Est. Ciencias*, Serie Mat.-Fis., **5**, 51. *rendus*, **193**, 358; 1931.
[6] *Cont.*, etc., **5**, 504; 1931; and *Phys. Zeit.*, **33**, 1
[7] *Cont.*, etc., **5**, 511; 1931; and *Phys. Zeit.*, **33**, 15

Magnetic Analysis of Molecular Orienta in Crystals

By correlating the magnetic constants of a dian netic crystal with those of the individual molecu constituting it, calculated from measurements on the magnetic double refraction of the substance in the liquid state, or from other considerations, it is possible to obtain direct information regarding the orientations of the molecules in the crystal. In a paper which is in course of publication, the results of some magnetic measurements by Mr. S. Banerjee and me on a number of organic crystals are discussed from this point of view.

It is found that in favourable crystals it is possible by the above method to locate the precise molecular orientations. The cases of biphenyl and dibenzyl may be quoted here as examples. Both of them crystallise in the monoclinic prismatic class, in the space group C^5_{2h}. There are two molecules in their unit cells. Their orientations determined from the magnetic measurements are as follows. Let us for brevity define the directions of the lines joining the carbon atoms 4 and 1 in the molecule (in the usual notation), or the atoms 1′ and 4′, as the length of the molecule, and the plane of the benzene rings as the molecular plane. We then find that the lengths of both the molecules in the unit cell lie in the (010) plane in the obtuse angle β, their inclination to the c axis being 20·1° in biphenyl and 83·9° in dibenzyl. As regards the molecular planes, in either crystal, one half of the molecules have their planes inclined at + 59° to the (010) plane and the other half at − 59° to it.

In the case of dibenzyl, sufficient X-ray data are not available to enable us to test the above conclusions. Our results for biphenyl, however, are fully confirmed by the recent X-ray measurements of Dhar,[1] whose values for the above angular parameters are 20° and 58° respectively, which are almost the same as our values.

K. S. KRISHNAN.
Physics Laboratory,
University of Dacca, July 6.

[1] *Ind. J. Phys.*, **7**, 43; 1932.

Formaldehyde in Rain Water

SINCE 1864, when Baeyer stated his formaldehyde hypothesis, numerous attempts have been made to obtain formaldehyde *in vitro* from carbon dioxide and water on exposure to light. Usher and Priestley,[1] Baly, Heilbron and Barker,[2] Dhar and co-workers,[3] Mezzadroli and collaborators,[4] and others, obtained evidence of formaldehyde formation from carbonic acid or bicarbonates in presence or absence of catalysts when exposed to light. On the other hand, Spoehr,[5] Baur and Rebman,[6] Potter and Ramsperger,[7] Bell,[8] Emerson,[9] Zschiele,[10] and Mackinney [11] obtained negative results, although the last-named worker made the following statement: "The status of this problem is extraordinarily involved, though it can be

...ucceeded in obtain-
...cently, Baly and co-
...heir earlier results.
...tion of formaldehyde is
...ions of short wave-lengths,
...nsity is absolutely essential,
...is field could not obtain form-
...he low light intensity used. In
...tion, Dhar and Atma Ram[13] have
...n larger yields of formaldehyde by
...ion of carbonic acid and bicarbonates
magnesium, cerium, etc.
...nown that carbonic acid and water vapour
...e atmosphere, and under the influence of
...t light from the sun, they should combine
...n formaldehyde and oxygen. Hence it seems
...ble that formaldehyde should be present in the
...osphere.

...f appreciable amounts of formaldehyde were present in the atmosphere, it should be partially washed down with rain water. In the last few months, in order to test whether formaldehyde occurs in rain water, we have analysed numerous samples of freshly collected rain water obtained at Allahabad, Barlowganj (Mussorie)—altitude 5500 ft.—and at a village about three hundred miles from Allahabad. In all cases, we have got immediate and definite evidence of the existence of formaldehyde in both distilled and undistilled rain water, as tested by Schiff's reagent, Schryver's reagent, and by the reduction of ammoniacal silver nitrate.

From our experiments, we are of opinion that formaldehyde is actually present in rain water collected in these parts, and it is washed down from the atmosphere. In view of the fact that it is always present in rain water collected in a city, a village, and at a place of high altitude and far from human habitation, it appears that the formaldehyde present in the atmosphere is obtained from the combination of carbon dioxide and water vapour in the presence of the solar ultra-violet light, and not from the decomposition of substances of vegetable origin on exposure to light.[14] It will be interesting to note here that, several years ago, Henriet[15] reported the presence of formaldehyde in air but was not supported by Gautier.

Moreover, in a recent communication,[16] it has been shown from spectroscopic evidence that formaldehyde, like cyanogen, may be present in the absorbing atmosphere of the sun. It will be highly interesting if workers in other countries can also detect formaldehyde in rain water, and I would direct their attention to this matter. Formaldehyde present in the atmosphere and rain water even in small quantities serves as a ready-made plant food and stimulant,[17] and as an antiseptic which can purify the air and act as a disinfectant for the soil.

N. R. DHAR.
ATMA RAM.

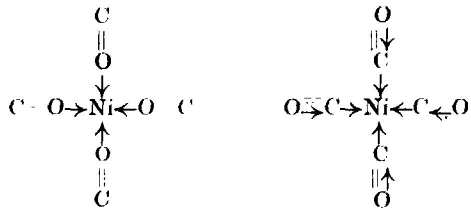
Chemical Laboratory,
University of Allahabad,
Allahabad, June 30.

[1] *Proc. Roy. Soc.*, B, **84**, 101; 1911.
[2] *J.C.S.*, **119**, 1025; 1921.
[3] *J. Phys. Chem.*, **29**, 926; 1925: **35**, 1418; 1931: **36**, 567; 1932.
[4] *Atti Accad. Lincei*, **6**, 160; 1927: *Gazetta*, **59**, 305; 1929.
[5] *J. Amer. Chem. Soc.*, **45**, 1184; 1923.
[6] *Helv. Chim. Acta*, **5**, 928; 1922.
[7] *J. Amer. Chem. Soc.*, **47**, 79; 1925.
[8] *Trans. Faraday Soc.*, **27**, 771; 1931.
[9] *J. Gen. Physiol.*, **13**, 163; 1929.
[10] *J. Amer. Chem. Soc.*, **54**, 973; 1932.
[11] *Ibid.*, **54**, 1688; 1932.
[12] *Proc. Roy. Soc.*, A, **116**, 212; 1927.
[13] NATURE, **129**, 205; 1932.
[14] Compare Spoehr, *Biochem. Z.*, **57**, 95; 1913: Moore and Webster, *Proc. Roy. Soc.*, **90**, 168; 1918.
[15] *C.R.*, **138**, 203, 1272: **139**, 67; 1904.
[16] Dhar, *Z. anorg. u. allg. Chem.*, 1932.
Compare Sir J. C. Bose, "Physiology of Photosynthesis", Long- ... p. 71.

Electric Dipole Moment of Nickel Carbonyl

WE have recently determined the total and the electron polarisations (the latter as the molecular refractivity for the mercury green line 5461) of nickel carbonyl in carbon tetrachloride solution at 0° C., and found values of 39·5 c.c. and 37·3 c.c. respectively. The latter value is somewhat higher than that of 35·5 c.c. calculated from the data of Mond and Nasini,[1] who used the pure substance, for the thallium line 5351, but it is probably not in error by more than $\pm 0 \cdot 1$ c.c., and the difference may be attributed to the difference of concentration. The apparent orientation polarisation of 2·2 c.c. would give the maximum possible value of the electric dipole moment as $0 \cdot 3 \times 10^{-18}$ e.s.u., but since it is of the order which would be expected for the atom polarisation of such a molecule, the moment may be taken to be zero with a high degree of probability.

This result shows that the structure must be symmetrical, and therefore cannot be cyclic, as suggested by Sugden,[2] nor can the structure be as shown in formula (*a*), in which co-ordinate links are formed



(*a*) (*b*)

between doubly bound oxygen atoms and the central nickel atom, for in this the co-ordinate link and the double bond on each oxygen atom would, on the tetrahedral atomic model, not be collinear, so that by partial rotation about the former links the molecule would become unsymmetrical and, like the methyl and ethyl orthocarbonic esters (electric dipole moments 0·8 and 1·1 respectively),[3] would have a finite moment.

The only structure which could be symmetrical is that shown in formula (*b*), or a similar one with the co-ordinate links between oxygen and nickel. This, which is derived from the co-ordinate triple link structure for carbon monoxide suggested by Langmuir and discussed by Hammick, New, Sidgwick, and Sutton,[4] would be symmetrical if the co-ordinate links, which must be collinear with the triple bonds, were directed either along the axes of a regular tetrahedron or to the corners of a square. It is more likely that the co-ordinate links to the nickel atoms would be formed by the acceptor carbon atoms than by the donor oxygen atoms, and so the former of the structural isomers here possible is the more probable. In either, the third quantum group of the nickel atom is completely filled with unshared electrons, and the valency group is a fully shared octet: such a structure is in complete accord with the diamagnetic nature of the substance.[5] Since no *d* electrons are utilised in attaching the CO radicals, it follows from Pauling's theory[6] that the tetrahedral arrangement is far more probable than the planar one.

The classical hypothesis that a triple bond and a single one on the same atom are collinear has been attacked by Bergmann,[7] who cites electric dipole moment evidence against it, but his arguments are not convincing. It has been given theoretical support by Pauling,[6] and has been proved correct experimentally for the cases of acetylene and hydrogen cyanide,[8, 9] by examination of the spectra, which show that the molecules are rectilinear.

This result is further support for the co-ordinate triple link structure ascribed to the other divalent carbon compounds, the *iso*-cyanides.

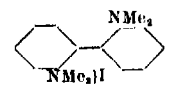
L. E. SUTTON.
J. BREEZE BENTLEY.

Dyson Perrins Laboratory,
Oxford, Aug. 1.

[1] Mond and Nasini, *Z. Phys. Chem.*, **8**, 150; 1891.
[2] Sugden, "The Parachor and Valency", London, 1930, p. 189.
[3] Ebert, Eisenschitz, and v. Hartel, *Z. Phys. Chem.*, B, **1**, 94; 1928.
[4] Hammick, New, Sidgwick, and Sutton, *J.C.S.*, 1876; 1930.
[5] "International Critical Tables", vol. 6, p. 358.
[6] Pauling, *J. Amer. Chem. Soc.*, **53**, 1367; 1931.
[7] Bergmann and Tschudnowsky, *Z. Phys. Chem.*, B, **17**, 116; 1932.
[8] Hedfeld and Mecke, *Z. Physik*, **64**, 151; 1930. Mecke, *ibid.*, 173; 1930.
[9] Badger and Binder, *Phys. Rev.*, **37**, 800; 1931.

Stereochemistry of Diphenyl

THE stereochemistry of diphenyl, as was shown in the "Research Items" in NATURE for April 2, p. 512, in reference to a paper by Prof. R. Kuhn, continues to produce problems of great interest. At a meeting of the Chemical Society held on May 5, a new 'dynamic' effect of groups in the 2:2′ positions was described.[1] We have now effected the optical resolution of the monomethiodide of 2:2′-bisdimethylaminodiphenyl:



The *d*- and *l*-methiodides have $[\alpha]^{20°}_{5791} \pm 48°$ in aqueous solution, in which ionisation is complete, and cold solutions retain their activity for indefinite periods. In aqueous solution at 100°, half-racemisation occurs in just over two hours.

The dissymmetry of the methiodide molecule can only be due to the dynamic effect of the three methyl radicals attached to the nitrogen atom, which, it should be noted, is the smallest atom possessing a tetrahedral configuration. The various implications of our results are being investigated.

F. R. SHAW.
E. E. TURNER.

Department of Organic Chemistry,
Bedford College for Women,
University of London,
Aug. 5.

[1] Lesslie and Turner, *J.C.S.*, 2021; 1932.

The Ring System of Sterols and Bile Acids

THE constitutional formula tentatively suggested by Butenandt[1] for the hydrocarbon $C_{18}H_{14}$ obtained by him from ketohydroxy-œstrin (follicular hormone) is closely related to the new constitutional formula of sterols and bile acids previously advanced by Rosenheim and King.[2] The applicability of this formula to the basic ring system of ketohydroxy-œstrin and pregnandiol (see Bernal[3]) was, indeed, expressed in our preliminary note, and the work of Marrian and Haslewood[4] and that of Butenandt (see above) supplies welcome experimental evidence in its favour.

It may be recalled that the essential principle of the formula proposed by ourselves consists in the grouping of three six-membered rings (I., II., and III.) as in phenanthrene, an arrangement which at once permits of a straightforward formulation of those experimental facts, for which the hitherto accepted formula (Windaus-Wieland) afforded no adequate explanation. Chrysene formation from such a ring system can obviously take pla is six- or five-memb of the adjoining CH_3

In the circumstances Dr. Butenandt to refer, fo posed ring system, to papers which are still "in the press authors will be found to prefer formula with a five-membered latest available publication from tory[5] our formula with a six-memb adopted.

O. R
H. Ki

National Institute for Medical Research,
London, N.W.3, Aug. 15.

[1] NATURE, **130**, 238, Aug. 13, 1932.
[2] *Chem. and Ind.*, **51**, 464; 1932.
[3] *Chem. and Ind.*, **51**, 466; 1932.
[4] *Lancet*, II., 282; 1932.
[5] *Lieb. Ann.*, **497**, 130; 1932.

Hall Effect in Beryllium

I HAVE recently carried out work on the Hall effect in beryllium, by using a plate measuring 1·5 cm. × 1·5 cm. × 0·045 cm., which was prepared, for this purpose, by Siemens and Halske of Berlin, from a sample of pure beryllium (99·5 per cent). I made use of Hall's classical experimental arrangement, and measured the e.m.f. by means of a potentiometric method with the use of a very sensitive Siemens and Halske's "Pancergalvanometer".

A large Weiss-type water-cooled magnet (made by Max Hohl of Chemnitz) capable of producing field strengths up to 27,500 gauss in a 4 mm. gap, the pole faces being 15 mm. in diameter, was used.

Many measurements were taken by varying the intensity of the current, and that of the magnetic field up to a maximum of 500 milliamperes and 27,500 gauss respectively.

The effect was very small and positive; the value of the Hall coefficient was found to be $+0·0024 \pm 0·0001$.

A detailed account of the experiments will be published shortly.

A. CICCONE.

Physical Institute of the University,
Pisa, Italy, July 23.

Absorption of Boron Neutrons by Lead

WHILE examining the absorption of neutrons emitted from boron bombarded by α-rays from an ampoule of radium emanation, we have been able to establish a phenomenon which seems worthy of attention.

The absorption of beryllium neutrons by lead is greater than by an equal thickness of copper or paraffin. Boron neutrons appear to possess less energy than beryllium neutrons, and are more absorbed by copper and paraffin wax than by lead. To the neutrons from boron, lead is very transparent, a screen 5 cm. thick showing scarcely any appreciable absorption, as shown by the number of recoil nuclei.

During a discussion at the International Electrical Congress recently held at Paris, Prof. Fermi put forward the suggestion that this phenomenon can be approached along the lines of the Ramsauer effect, the wave-length, h/mv, of the neutrons possibly being of the same order as that of the effective radius of a nucleus.

M. DE BROGLIE.
L. LEPRINCE-RINGUET.

Aug. 13.

Research Items

...illes (Dordogne).—Exca... caves in the neighbour... village on the banks of the ... west of Périgueux, have been ... Peyrony (*Mém.* 10, *Arch. Inst.* ...ne). The Grotte des Bernous ...sterian, followed immediately by ...ian, Lower Aurignacian being absent. ...aposition, and in some instances inter- ...Mousterian and Aurignacian suggests that ...usterian survived while Lower Aurignacian ... elsewhere, and was driven out by Middle ...cian tribes. The Fourneau du Diable fur- ...d a stratification of Aurignacian, Solutrean, and ...istat, while on the terraces lying above there were ...ree horizons of Solutrean. Many objects found were ...nique, such, for example, as a haft of reindeer horn socketed to take a stone implement, and a collection of coloured pebbles arranged in a quadrilateral figure. The latter, it is suggested, may have been fastened to some material, such as wood or leather, which has perished, and have been used as a dance rattle. The cultures of Bourdeilles throw new light on a number of questions. The development of the flint industry of the Solutrean can here be followed in detail and the first appearance observed of the implements, such as daggers and the *feuille de saule*, which were the forerunners of the weapons of neolithic times. From the evidence at Bourdeilles it is concluded that for a long time different peoples lived side by side and finally coalesced to adopt a single culture. This view is borne out by the occurrence, in what is virtually the same cultural horizon, of Chancelade man with his Eskimo characters and the man of Laugerie Basse, a Nordic type.

Moieties of the North-Western Mono, California.—In a study of the north-western Mono in the vicinity of Northfork, an affluent of the San Joaquin River (*Univ. Cal. Pub. Amer. Arch. Eth.*, vol. 31, No. 2), Mr. E. W. Gifford records that these people are divided into two moieties, which function in feasts, ceremonies, and games in reciprocity and in rivalry. Thus, at ceremonies or feasts, each moiety prepared food for the opposite moiety; but the moieties never ate together. At these feasts the children ate with the father; but the wife did not eat with her husband if she belonged to the other moiety. One moiety prepared and burned the dead of the other moiety, a service for which they received payment. At the mourning ceremony, which took place two years afterwards, they sang for and washed the mourners, fed them, and paid them. After the ceremony the mourners reciprocated with payment and a feast. The totemic animals, birds, were connected with the moieties, and not with the four divisions, of which two were assigned to each moiety. An individual, however, might consider all totems of his moiety as his own; but the golden eagle, although it was a totem of one of the moieties, was reverenced by everyone as the creator as well as the chief of the birds. If a man wished to kill his totem for its feathers, he explained matters to it, pointing out that it would not die, as he would take care of its feathers. If an eagle was killed by one of the vulture moiety, he brought the feathers to the eagle chief and paid for them. Each moiety had shamans. A vulture shaman who killed an eagle man by magic was killed by the eagle chief unless he had previously paid the eagle chief for the privilege.

Vocational Tests of Dexterity.—Vocational tests of ...ility are classified and psychologically estimated ...lie E. Weiss Long and Prof. T. H. Pear in Report No. 64 of the Industrial Health Research Board. English, American, French, and German publications are mentioned, and special prominence is given to the less familiar work of foreign countries, illustrations of test methods being drawn from them. The report opens with a discussion of 'skill' and the definition of it as "the integration of well-adjusted muscular performances". Thus understood, it needs a complex system of testing. Vocational research should concentrate on the specific psychological requirements of an occupation, and on determining the most appropriate tests for discovering whether, and in what degree, given individuals possess them. Hence, claims made for single tests in different countries cannot be substantiated. In selecting for an occupation demanding a fairly complex performance, it is of importance to use series of tests involving complex activities. The individual tests should be as numerous and diverse as possible, and the time allowed to do them should be fully adequate. It is not important that the single functions called into play should be identical with those required industrially. This comprehensive survey shows that less has been indisputably established than the vocational guidance promoters would like to think: but it also affords an excellent guide both to the available material and future lines of research.

Adaptation of Sand Reptiles to Environment.—In the Sahara and on the sandy plains of California, Walter Mosaner has been struck by the remarkable resemblances between the sand-inhabiting reptiles (*Copeia*, p. 72, 1932). These are not adaptations to desert conditions, which tend rather to affect behaviour, but structural changes due to the mechanical characteristics of the sand and the texture of the substratum. The changes are twofold: some are modifications facilitating locomotion on or in the sand, others serve for the protection of the sense organs and body openings. As some sand-dwelling mammals have adopted occasional bipedal locomotion, so many lizards assume a bipedal position when at top speed. The tracks in the sand show how different is the work accomplished by fore and hind feet, and with increasing speed the difference is accentuated until the fore-feet, and the tail also, are held clear of the ground. A curious locomotor adaptation common to Saharan and Californian snakes is the habit of 'side-winding', and many structural features, such as the stream-lined body, shovel-like snout, countersunk lower jaw and degenerate limbs, are associated with the habit of burrowing in the sand. Although perhaps less markedly, the protection of the eyes by fringe-like scales, of the tympanic membrane by overlapping scales, and of the slit-like nostril (in *Phyllorhynchus*) by the projecting edges of the nasal scales, all seem to be associated with the burrowing habit.

Copepods of Chesapeake Bay.—The peculiar conditions of Chesapeake Bay offer excellent opportunities for a detailed study of copepods, since in many cases they have a wide distribution and accommodate themselves to great and fairly rapid changes in salinity. Dr. C. B. Wilson shows ("The Copepod Crustaceans of Chesapeake Bay", by Charles Branch Wilson; No. 2915, *Proc. U.S. Nat. Mus.*, vol 80, Art. 15, 1932) that *Acartia clausi* is the most frequently occurring copepod in the Bay, next to it coming *A. longiremis*. These two species are largely eaten by the shad, and are of much greater economic importance than was previously realised. In March, when copepods are at their maximum, the largest hauls are made up almost

entirely of these two species, which breed twice a year, in winter and in summer. The March maximum is the product of the winter breeding, the young copepods having exceptionally good opportunities for growth, as there is then a relative scarcity of fishes and other animals which prey upon them. Later on, the numbers diminish rapidly, probably owing to the coming of the shad. The author finds four breeding seasons in Chesapeake Bay, in winter, spring, summer, and autumn, each characterised by several copepods bearing eggs. In the months following, nauplii and young are caught in numbers. Each copepod has one or two breeding seasons. The records indicate that water of higher salinity is more favourable to the breeding than the low salinity water at the inner end of the Bay.

Fauna of the Tay Estuary.—A study of the inhabitants of the Tay Estuary, made by W. B. Alexander for comparison with the corresponding fauna of the River Tees, reveals the different capacities of marine animals to penetrate upstream into the region of brackish and even fresh water (*Trans. Perthshire Soc. Nat. Hist.*, vol. 9, 1932, p. 35). The real marine fauna, characterised by the presence of limpets and common star-fishes and red sea-anemones, may be said to end near the Tayside Lighthouses. Two miles farther up the estuary, at the Tay Bridge, these have dropped out, and here periwinkles, the amphipod *Orchestia littorea*, three species of the sea-worm, *Nereis*, and a few others reach their limit. Beyond this, for ten miles farther, the shore-crab and some smaller crustaceans, the polyzoon, *Membranipora*, *Nereis diversicolor*, and the seaweeds, *Ulva* and the common bladder-wrack, penetrate. But here ends the conquest of marine forms over the influence of fresh water, and only two species of crustaceans, *Neomysis vulgaris* and *Corophium longicorne*, are found five miles farther on, at Newburgh, although adventurous flounders live in association with a fresh-water fauna twenty miles beyond the limit of the real marine fauna.

Hosts of Rust Fungi.—" Inoculation Experiments with some Heterœcious Species of the Melampsoraceæ in Japan ", by N. Hiratsuka (*Jap. J. Bot.*, vol. 6, No. 1, pp. 11-34 ; 1932), gives the results of very extensive inoculation experiments with the teleutospores and æcidia of heterœcious Melampsoraceæ. The interest is mostly local, but a well-defined specificity of the fungus *Melampsora larici-epitea* claims more general notice. Teleutospores from *Salix viminalis* v. *yezoensis*, *S. rorida*, and *S. sachalinensis* will all infect *Larix Kaemferi* and produce æcidia thereon, but æcidia from the three different sources will not interinfect the three species of *Salix*.

Petrogenesis of the Dartmoor Granites.—Many intensive studies of reaction between granite and country rock have been made during recent years by British geologists, but by far the most exhaustive is that carried out with brilliant success by Dr. A. Brammall in collaboration with Dr. H. F. Harwood on the Dartmoor granites (*Quart. J. Geol. Soc.*, **88**, pp. 171-237 ; 1932). The long-awaited record of this model of petrogenetic research, including, as it does, more than eighty detailed analyses of carefully selected series of rocks and minerals, constitutes an unrivalled storehouse of petrological and geochemical data and embodies a convincing discussion of the bearing of these data on many problems, hitherto elusive, of rock genesis. It is demonstrated beyond any possibility of doubt that the observed variation of rock-types cannot be the result of differentiation alone. The study of inclusions and contact-facies shows that an initial acid magma was basified and enriched in biotite and certain other minerals by reaction with the shales, diabases, and spilites of the invaded country r tion of xenoliths i ranging between types biotite-granite. It is c semblage of rock-types c for by the operation of a bi- tion and differentiation pr during the emplacement of the is impossible in a brief paragra direct attention to the quality and outstanding investigation. Both a order, and the authors are to be congra great achievement.

Coral Reefs and Raised Beaches of Japa not appear to be generally known that ree corals flourish in some parts of the Japane H. Yabe and T. Sugiyama (*Sci. Rep. Tôhoku Univ.*, Sendai, ser. 2, vol. 15, No. 2, 1932, p. 143) s that the more southerly islands (Riukiu, Ogasawar and Taiwan) have well-developed fringing reefs and bank barriers, with a breadth varying from 150 metres to 4000 metres. 202 species and varieties of corals have been recognised, a larger number than is found in either the Philippine or the Hawaiian Islands. Around the more northerly islands (Kiushû, Shikoku, and Honshû), owing to the influence of the warm current, reef corals thrive so far north as lat. 35° N. but do not form well-developed reefs. A living representative of *Stylocœnia*, a genus hitherto known only in the fossil state, has been found. Farther north, in the Kwantô region, raised beaches have been found at levels ranging from 4 metres to 20 metres above sea-level. S. Nomura (*ibid.*, p. 65) gives a list of 470 species of Mollusca found in these beaches. The majority of the species still live along the coasts of central Japan, but some only in western Japan or farther south. The raised beaches are regarded as of Neolithic and later date.

Upper Atmospheric Ionisation.—When the frequency of wireless waves incident on the Kennelly-Heaviside layer is being increased, a stage is reached when reflection is replaced by transmission, and the waves pass to the Appleton layer before return ; with further increase in frequency, the same occurs there, but the waves are now completely lost. From the critical frequency for transmission in each case the maximum density of the ions or electrons present can be calculated. The results of some routine measurements of this nature have been described by Prof. E. V. Appleton and Mr. Naismith (*Proc. Roy. Soc.*, July), principally for the lower layer. The ionisation has both annual and diurnal variations, as well as more irregular fluctuations, some at least of which are associated with magnetic storms. During the day, the ionisation is high, with a flat maximum near noon, and it is low at night, again with little change; the ionisation is heavier in summer than in winter. The full interpretation of the results depends on whether molecular and atomic ions or electrons are responsible for the reflection and transmission. If the negative particles are massive, their maximum concentration in the lower layer is about 10^{10} per c.c. in summer, but if they are electrons, the concentrations are only of the order of 10^5 per c.c. A better idea of the significance of the densities may perhaps be obtained from the fact that the number of electrons per c.c. in an Osglim lamp is of the order of 10^{10}, whereas 10^5 per c.c. corresponds more nearly to the state of a gas ionised by X-rays ; the analogy is not, however, complete, because the negative carriers in the Osglim lamp are mainly electrons, and not molecular or atomic ions. Actually it is known from other lines of reasoning that the negative particles in the upper layer

...ver layer at least

...ocity Positive Ions.—...ockcroft and Dr. E. T. S. ...tegration by protons is de- ...of the *Proceedings of the Royal* ...n takes place most readily ...boron and fluorine also give more ...of the number of particles from ...kilovolts, uranium, aluminium, and ...n 1 and 2 per cent, and beryllium, ...alt, nickel, copper, and silver between ...per cent. Oxygen, sodium, potassium, ...lead give very small numbers, and in some ...is not yet certain that the effect is not due ...disintegration of impurities. The disintegra- ...of uranium is of particular interest, in view of ...natural activity, but the artificially produced ...particles appear to have a longer range than the natural ones. Several elements, including beryllium, give two types of particles, presumably with different energies. The majority of the experiments on the properties of the emitted particles have been done with those from lithium. With this element, there can be very little doubt that α-particles are formed, and that they are almost homogeneous in speed, and produced in pairs. From their range, it is calculated that 17 million electron volts of energy are released, in agreement with the 14 ± 3 million electron volts required from the mass defects of the various nuclei involved, but the number of disintegrations taking place is smaller than would be expected from the quantum theory of the effect. In view of the very small chance of protons of 500 kilovolts penetrating the potential barrier of a heavy nucleus in any way other than by resonance, it would appear probable that this is the process coming into operation. It is noteworthy that the three elements—lithium, boron, and fluorine—which give the largest emission of particles also show a similar change in emission with increase in the speed of the incident protons. These elements are all of the $4n+3$ nuclear type, with nuclei presumably made up of α-particles with the addition of three protons and two electrons, so that it is reasonable to suppose that capture of a proton may lead to the formation of a new α-particle inside the nucleus.

Neon Isotopes.—By the aid of a new diffusion process, Prof. G. Hertz has now effected a practically complete separation of the lighter isotope of neon (*Naturwiss.*, June 24). The process is an elaboration of the principle of differential diffusion through porous tubes, and is carried out in a train of twenty-four interconnected elements, controlled by mercury vapour pumps. A single run of eight hours, starting from ordinary neon with a 10 : 1 isotope ratio, gave either a mixture with a 10 : 8 ratio or one with only about one per cent of the heavy isotope. The experiments were controlled by a mass-spectrograph, and by study of the fine structure of the neon spectrum with an interferometer. Evidence was obtained by the former method that there is a fourth isotope of neon with mass 23, in addition to the common pair with masses 20 and 22, and the rarer isotope of mass 21.

Astronomical Topics

Astronomical Notes for September.—Mercury is in elongation as a morning star on Sept. 3; 18° from the sun. Venus is in elongation as a morning star on Sept. 8; 46° from the sun. Being north of the sun, it is well placed for observation.

There is an almost total eclipse of the moon (magnitude 0·982) on the evening of Sept. 14. The moon enters the umbra at $7^h\ 18^m$, and leaves it at $10^h\ 43^m$, the maximum eclipse being at $9^h\ 0^m$. The sun sets in London at $6^h\ 18^m$. Study should be made of the brightness and colour of the eclipsed region.

There is only one occultation visible in London at a convenient hour; 27 Capricorni disappears at $6^h\ 44^m$ on the evening of Sept. 11.

Saturn passed opposition in July, but is still observable, though low down. Uranus is observable in Pisces; it reaches opposition in mid-October. A map of its track among the stars is given in the B.A.A. Handbook for 1932.

The comet Peltier-Whipple was visible with an opera-glass in August, and should still be an easy telescopic object in September. The following ephemeris for 0^h is from the Whipple-Cunningham orbit:

		R.A.			N. Decl.	
Sept.	2	9h	57m	36s	79°	47′
	6	11	44	44	76	22
	10	12	35	45	72	12
	14	13	3	14	68	16
	18	13	20	12	64	48
	22	13	31	56	61	46
	26	13	40	32	59	7
	30	13	47	16	56	46
Oct.	4	13	52	48	54	45
	8	13	57	28	52	56
	12	14	1	40	51	22

The comets Newman and Borrelly need more powerful instruments; an ephemeris for Newman is given in the *Observatory* for August and September; ...orrelly, use the B.A.A. Handbook, applying the ...iven there for perihelion one day later than the assumed value. The Handbook also gives a search ephemeris for Tempel's comet, 1866 I; all astronomers who have suitable means are asked to join in the search for this comet. Its detection would enable the past history of both the comet and the Leonid meteors to be placed on a firmer footing.

The sun crosses the equator and autumn begins at $6^h\ 24^m$ on the morning of Sept. 23.

Add 1^h to all times given, to reduce to Summer Time.

The Welsh Meteor of April 14, 1931.—Loud explosive sounds were heard over North Wales on the morning of April 14, 1931. Some of the daily papers described it as an earthquake; Mr. B. M. Peek, who was on the mountain Moel Siabod, sent an article to the British Astronomical Association, in which he made the conjecture that the sounds were due to the passage of a large meteor which probably fell in the Irish Sea. The *B.A.A. Journal* for June 1932 has another article about it, by Mr. A. King. His researches have placed the meteoric character of the object beyond doubt; two observers, in Ripon and Leeds, actually saw the meteor; many people in Yorkshire heard the sounds, which some took for thunder; moreover a fragment of the meteor was seen to fall at Coch-y Bug Farm, a few miles south of Carnarvon. Dr. Spencer has seen this fragment, and pronounces it to be a genuine meteorite, "apparently of an unusual type". Mr. King has investigated the real path of the meteor; the calculated earth-point is some eighteen miles west of the farm where the fragment fell; the visible path appears to have begun over Bakewell and ended over Mold. The velocity was not much less than parabolic, the radiant being 177° from the apex, so that the meteor was overtaking the earth. It is satisfactory that it has been possible to determine so much about this interesting meteor. From the loudness of the sounds it is conjectured that by far the largest portion of the meteor fell in the sea.

The Total Solar Eclipse of Aug. 31

AN account of the work which is being undertaken in connexion with the total solar eclipse of Aug. 31 by the three British expeditions in Canada under the auspices of the Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society appeared in NATURE of July 23, p. 116.

The Imperial College expedition to Montreal will be located on the roof of the Molson Hall of the Arts Building of McGill University, where Prof. Ira Mackay has kindly placed every facility at the disposal of the observers. The site will afford a good view of the sun, the intervening ground being occupied mainly by a reservoir and the wooded slopes of Mount Royal, so that a very steady image of the sun should be obtained. An excellent dark room and source of electric current are convenient of access. The observations are in charge of Prof. H. Dingle, who will be assisted by members of the McGill University staff and students. Through the kindness of Prof. A. S. Eve, the resources of the Macdonald Physics Laboratory and workshops have been made available to the observers, and if the weather is favourable there is every prospect that the expedition will be as successful as the nature of the programme allows.

Two problems are to be attacked. First, the photography, with large dispersion (about 0·7 A. per mm.) of the bright-line spectrum at the cusp of the partially eclipsed sun, which was observed visually by Prof. A. Fowler at South Kensington in 1912. Owing to the extremely short length of slit which will be illuminated (a small portion of a millimetre up to a few minutes before totality with the 2-inch solar image which is to be used), the possibility of success in this part of the programme is somewhat speculative. Provision, however, has been made for both rotatory and translational motions of the sun's image in immediate obedience to the desires of an observer watching the slit through a small telescope, and strong hopes are entertained of a successful issue. The second problem is the photography, with the same dispersion, of the Fraunhofer spectrum at the limb of the sun just before and after totality, in order to obtain precise wave-lengths of the limb-light free from atmospherically diffused disc-light, which is unavoidable during full sunshine.

The intense interest which the eclipse is arousing in America is evidenced by an extensive series of bulletins issued by Science Service, of Washington, D.C. They are divided into two parts: first, information on the nature of eclipses in general, their history, and methods of predicting them; secondly, the arrangements on the present occasion, the locations and plans of the various parties. Thus we note that this will be the ninth totality observed by Dr. S. A. Mitchell, of Leander McCormick Observatory, who will use at Magog the large concave gratings that he used at Tin Can Island in 1930 to study the height of different gases in the solar atmosphere. The Franklin Institute will photograph the corona with a camera 85 feet long, recalling the long refracting telescopes of pre-achromatic days. The Georgetown party, under Dr. P. A. McNally, *S.J.*, will take photographs to measure the Einstein shift of stars; the star-field is not, however, very suitable, and totality is rather short for the purpose; the party will also investigate the infra-red spectrum of the corona. The astronomical artist, Mr. H. R. Butler, has made long journeys to paint total eclipses, but on this occasion he will enjoy 93 seconds of totality at his own home. Mount Washington, which is 6288 feet high and the highest point in the path of totality, will be occupied by a Science Service party, who will endeavour to take photographs of the moon's shadow on the gro photographs. Astronomica been a special feature of the Angelus, Michigan; a party motion films during totality.

The U.S. Naval Observatory will time signals from 1.55 to 2.0 P.M. an 4.0 P.M. Eastern Standard Time on Au progress of the eclipse will be describe to those outside the track.

The effect of the eclipse on radio observat be investigated. The distinction between the eclipse and the eclipse of the corpuscular strean discussed by Profs. S. Chapman and E. V. Apple in a letter in NATURE of May 21, p. 757. The Fren and Dutch Polar Year parties will be near the centre line of the optical eclipse, and will make special observations on layer heights. The British party at Tromsö will be near the sunset limit, as will stations in south-east England. The Tromsö workers will, however, measure the densities of ionisation at the time of the eclipse, with control observations on adjacent days, and corresponding measurements will be made at King's College, London, the Radio Research Station, Slough, and at the Cavendish Laboratory, Cambridge. Special observations on trans-Atlantic signals will be made at Slough and at Post Office stations, with special regard to the fact that the particle eclipse may be total over nearly the whole width of the Atlantic at once.

Parties from the U.S. Bureau of Standards, Washington, under the direction of Dr. J. H. Dellinger, will record eclipse effects on the field strengths of radio waves and on the heights of the ionised layers.

Through the Associate Committee on Radio Research of the National Research Council of Canada, three Canadian parties will also undertake radio observations. An effort is to be made to investigate the variations of the Heaviside layers during the passage of the shadow, and to test the theory advanced by Prof. S. Chapman, that the Appleton layer is ionised by ultra-violet light and the Kennelly-Heaviside layer by a stream of corpuscles or of neutral particles.

One party, under the direction of Lieut.-Col. Steel and Dr. Rose, of the National Research Laboratories, Ottawa, is to investigate the upper layer from a point in Kingston, Ontario. Another party, under the direction of Prof. A. S. Eve, of McGill University, and consisting of Messrs. Ross and Stadler, is proceeding to Corner Brook, Newfoundland, to study the 'corpuscular eclipse', which it is calculated will take place to the east of the optical shadow band. A third party, under the same direction and consisting of Messrs. Henderson and Smythe, is proceeding to Vankleek Hill, south-west of the Ottawa River and below the city of Ottawa, to take observations on the Kennelly-Heaviside layer, with the object of determining the ultra-violet light effect. Both Vankleek Hill and Kingston are to the west of the optical shadow band on the surface of the earth.

The Canadian Marconi Company and Northern Electric Company are co-operating with the National Research Council in these investigations. The former will take continuous field strength measurements in the short-wave band, while the latter will take similar measurements at broadcast frequencies. The results of their measurements will check the information obtained by the other parties.

During the eclipse, Messrs. Laurence and Howlett of the National Research Laboratories hope to vestigate the origin and appearance of shadow

he Deterioration of Paper on Ageing

anence of paper is one
terest to scientific workers.
volume of scientific publica-
oncern to all learned societies,
their financial resources to the
eep in pace with it. It is unfortu-
cases the printing quality and the
eel of a paper have been the principal
have influenced those choosing it, but
ities do not necessarily go hand in hand
nence, future generations of members may
the efforts of their predecessors have been

e problem is one of recent origin, for it is only
e 1860, 1870, and 1880 respectively that esparto
ass, mechanical wood pulp, and chemical wood pulp
have been used in paper-making. Prior to 1860, rags (that is, cotton, flax, and hemp) were the usual raw materials, and although excessive loading, bleaching, or alum may shorten the life of rag papers, they are generally recognised as being the most permanent. This fact was, indeed, recognised so far back as 1898 in a Report to the Royal Society of Arts, in which it was stated that esparto and straw papers are more permanent than mechanical pulp papers, but less permanent than chemical pulp papers. It was therefore specified that permanent book papers should contain less than ten per cent of loading and not less than seventy per cent of rag.

Subsequent work in the United States and in Germany has modified the inferences drawn from this Report, since it has been shown that the method of manufacture of the paper and the conditions of storage are equal in importance to the nature of the fibre in determining how long the paper will last. Bulletin No. 2795 (1912) of the American Newspaper Publishers' Association, for example, points out that excessive dryness (resulting from the artificial heating of libraries) and excessive dampness may alter the normal moisture content of the paper, and so stimulate its deterioration. Cases are on record in which a badly-made rag paper had undergone rapid deterioration, whilst at the other extreme hand-made mechanical wood-pulp has been stored under proper conditions for a hundred years and still shows no sign of ageing.

A Committee of the League of Nations also pronounced in favour of unbleached rag papers in 1928, and quite recently the investigation has been taken up by the Bureau of Standards in the United States (*Miscellaneous Publication* No. 128, *Research Papers* Nos. 349 and 352). Not only have opinions been expressed as to storage conditions, but in addition, what appears at first sight to be a revolutionary recommendation is made, namely, that the paper may be prepared from any fibres except those of unbleached or mechanical wood-pulps. The great difficulty in arriving at trustworthy results is due, of course, to the impossibility of carrying out tests under the conditions of practice. Not only would this take too long, but it must also be remembered that the earliest commercial papers made from wood or esparto are not more than seventy-five years old, and, moreover, that the extensive improvements in manufacturing methods in the meantime have resulted in a corresponding improvement in the paper of to-day. The Bureau of Standards and others have therefore had to resort to accelerated ageing tests, the actual technique of which varies from one investigator to another and may involve heating for seventy-two hours at 40° to 100° C., with or without exposure to sunlight or ultra-violet rays.

B. L. Wehmhoff, who as technical director of the Government Printing Office at Washington must be regarded as an authority on such matters, has recently devoted some attention to them in a paper before the Technical Section of the Pulp and Paper Industry (*Proceedings*, **94**, 57; 1932). The paper is of value not so much as an account of original work, but because the author has collected the personal opinions of a number of paper experts all over the world on the value of accelerated ageing tests.

The opinions differ widely, but there seems to be general agreement that a temperature of 100° C. corresponds with rather drastic treatment, and, moreover, that the type of deterioration produced by heat and light is not necessarily the same as that which occurs on storage. Opinions also differ as to the value of chemical tests as a means of determining the permanence of paper. This applies particularly to the α-cellulose value, for all agree that the copper number, rosin content, and acidity (or pH value) should be as low as possible. The effects of traces of impurities also require investigation; for example, there is reason to believe that ferrous iron accelerates the deteriorating influence of rosin.

It is not surprising that specifications for the same type of paper proposed by different bodies are by no means identical. A Report on the subject to H.M. Stationery Office is a cautious and balanced statement of the available facts, and few responsible for the purchase of paper will disagree with the opinions expressed. The Report states that there is no evidence that papers made from esparto or chemical wood deteriorate if stored under proper conditions. At the same time, new, clean, white or unbleached rags are preferable for the best papers, and whenever it is a question of choosing between esparto and chemical wood, the former should be rejected. J. G.

Early Man in Algeria

IN the course of a recent note on dental mutilation (see NATURE, Aug. 20, p. 268) reference was made to its occurrence in fossil human remains from Afalou-bou-Rhummel. A communication presented to the first International Congress of Prehistoric and Protohistoric Sciences by MM. Marcellin Boule and Henri Vallois, on "The Fossil Men of Afalou-bou-Rhummel (Algeria)", was welcomed as an authoritative statement on "a new type of fossil man" from North Africa. Prehistoric human skeletal remains have been discovered in North Africa on several occasions, but unfortunately most of them—from the shell-heaps Tunisia and near Constantine as well from certain
n caves—cannot be dated with certainty. The type of Afalou agrees with the type already discovered in Algeria, but the deposits in which previous discoveries have been made are usually regarded as of neolithic age.

The human remains studied in the communication by MM. Boule and Vallois belong to at least fifty individuals; and although they were scattered, nine skeletons have been reconstructed. The cave in which they were found is known by the name of Afalou-bou-Rhummel, and is situated on the Algerian littoral in the commune of Oued Marsa. The cave was excavated in 1928 and 1929 by M. Arambourg with the financial assistance of the Institut de Paléontologie humaine. Both stratigraphical and archæo-

logical evidence point to the dating of the remains as definitely Pleistocene and their cultural horizon as Upper Palæolithic.

The remains are homogeneous in character. The skull is pentagonal, about equal numbers being mesaticephalic or dolichocephalic, and a small number brachycephalic. It is moderately high. Sometimes the occiput tends to be chignon-shaped. The forehead is receding and the supra-orbital arches are united in a well-developed prominence at the glabella. Almost all the skulls have a brutal aspect. The face is short and broad; the nose platyrrhine or, at times, mesorrhine. The orbits are low. There is no prognathism. The bones of the skeleton as a whole are very robust, the muscular attachments strongly marked. Stature is below the mean. Sometimes the upper incisors had been knocked out early in life.

Similar skulls have been obtained from the shell-heap of Mechta el-Arbi near Constantine, notably by MM. Debruge and Florance in 1913, and others have been discovered since that date in excavations by M. Debruge.*

The type of Afalou is new. It bears no resemblance to Neanderthal man or to the Mediterranean or negro types of modern times. It differs from Cro-Magnon and, markedly, from Asselar man (see NATURE, Aug. 20, p. 280) notwithstanding the common cultural feature it shares with the latter in the practice of evulsion of the upper incisors. It is, therefore, proposed that the type should be known as the Mechta race, from the site on which it was first found; and it is to be regarded as associated with the Capsian culture.

* Sir Arthur Keith refers to four skeletons excavated from the kitchen-midden at Mechta el-Arbi by Mr. Alonzo W. Pond in 1927 and described by Dr. Fay-Cooper Cole. Sir Arthur accepts the attribution of the site to the Capsi.n culture. *See* "New Discoveries relating to the Antiquity of Man", London, 1931, pp. 213-214.

University and Educational Intelligence

LONDON.—The following degrees have been conferred: D.Sc. in anatomy on Solly Zuckerman (University College) for a thesis entitled "The Menstrual Cycle of the Primates"; D.Sc. in biochemistry on Margaret A. C. Fixsen (Lister Institute of Preventive Medicine) for a thesis entitled "The Effect of Desiccation on the Nutritive Properties of Egg-white"; D.Sc. in zoology on Norman J. Berrill (University College) for a thesis entitled "Studies in Tunicate Development, Part II. Abbreviation of Development in the Molgulidæ" (*Phil. Trans.*, B, vol. 219); D.Sc. (Engineering) on Charles Edward Larard (Northampton Polytechnic Institute) for published papers on experimental and mathematical investigation dealing with the viscous and elastic straining of ductile material, together with their original work; D.Sc. in metallurgical chemistry on Frank Adcock (private study) for thirteen independent published works, together with two subsidiary contributions; D.Sc. (Engineering) on George A. Tomlinson (private study) for fifteen published papers on (1) atomic forces and cohesion, (2) applications of metrology to engineering problems, together with three subsidiary contributions.

The London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, has issued a pamphlet detailing the post-graduate courses of instruction in preventive medicine given at the School. These comprise courses of study for the diplomas in public health and in tropical medicine and hygiene, and an advanced course of study for the diploma in bacteriology. A brief synopsis of the course is included in each case.

READING.—The
Research in Dairyi.
appointed Prof. H. ı
Institute in succession ‹
Williams. Prof. Kay, wl.
biochemistry in the Univei.
in 1893 and educated at Man‹
and the University of Manches
experience in the conduct and ‹
work in Great Britain before pro‹
in 1929. The majority of Prof. Kay
tions deal with oxidation in the
chemistry of bacterial activity, enzym‹
of milk, chemistry of phosphorus compou.
relationship to living processes, vitamin D,
teins, and the biological significance of phos
Prof. Kay hopes to take up his duties at the Ins
towards the end of the present year.

Calendar of Geographical Exploration

Aug. 31, 1873.—Franz Josef Land

Julius Payer discovered this arctic archipelago. An Austrian polar expedition had been prepared by Count Wilczek, and Payer and Weyprecht in the *Tegetthof* set out in 1872. While the ship was beset by ice, high land was seen to the north-west and later in the season Payer led expeditions to Hochstetter and Wilczek Islands. After a second winter in the ice-bound ship, a difficult journey northwards to Cape Fligely, 82° 5′ N. (Rudolf Land), was made. This remained the highest northern latitude reached until 1859. Mountain ranges indicating land beyond the eighty-third parallel were seen. B. Leigh Smith in 1881–82 explored the whole southern coast from 42° to 54° E., discovering many islands and sounds. In 1894, Alfred Harmsworth fitted out an expedition in the *Windward* under F. G. Jackson, with the object of establishing a base in Franz Josef Land for an attempt on the north pole. In 1896 the Harmsworth-Jackson expedition reached Cape Richthofen and saw a great sea to the north. Nansen, on his southward journey, approached Franz Josef Land from the north-east, finally proving the existence of a deep sea basin to the north. Nansen wintered near Cape Jackson, Flora Island, a few miles from the point which Jackson had reached in 1895. On June 17, 1896, Nansen and Jackson met and the *Windward* brought Nansen home. The archipelago was further explored and used as a base for expeditions to the pole between 1897 and 1913.

Sept. 1, 1513.—Discovery of the Pacific

Vasco Nuñez de Balboa set out with a hundred Spaniards, among whom was Pizarro, and a thousand natives to cross the Isthmus of Panama. While in the town of Santa Maria de la Antigua del Darien, which he and Enciso had founded, he heard, from a native, accounts of the ocean beyond the mountains and of the gold of Peru. On Sept. 25 or 26, he reached the summit of the mountains and viewed the Pacific. Pizarro and two others had gone on in front, and one, Alonzo Martin, was the first European to embark on the newly found ocean, in St. Michael's Bay. On Sept. 29, Balboa reached the shore and took possession of the 'Great South Sea' for the Spanish monarch. He visited the Pearl Islands, once more heard of the gold of Peru, and returned in triumph to Darien in January 1514. He is said to have revisited the Pacific many times. He captured the Pearl Islands and prepared to conquer Peru, but through the jealousy of another official he was executed in 1517.

Lena Delta

...hev, reached 77° 29′ ...ape Chelyushkin. The ...t an expedition under his ...m Yakutsk, 900 miles from ...in 1735. After sailing down ...a delta, he reached the mouth ...nd wintered in some fur-hunters' ...ke up in Olonek Bay on Aug. 15, ...nischev proceeded north-west, almost ...ost northerly point on the coast. He ...ack by ice, but died of scurvy before ...ached the mouth of the Olonek River on ...his young wife, who had accompanied him, ... of scurvy.

...3, 1835.—The Russian Polar Seas

...Pachtussov reached Archangel after his second polar ...voyage, and shortly afterwards died from fatigue. His two expeditions were remarkable for the prudence and forethought which he displayed, the care which he showed for the health of his men, and notably for the wealth of astronomical, geodetical, meteorological, and tidal observations which he made. On his first journey, when wintering in southern Novaya Zemlya, in lat. 70° 36′ N., long. 59° 32′ E., meteorological observations were taken every second hour. Pachtussov was sent out in 1832 by citizens of Archangel to re-establish the sea-route to the Yenisei, to survey the east coast of Novaya Zemlya, and to hunt walrus in the latter place. On his first voyage he surveyed the east coast of Novaya Zemlya, and on his second Matotschkin Sound and the east coast of North Island, though his attempt to circumnavigate the latter failed. His second winter was spent on the south side of Matotschkin Sound, at the mouth of the River Tschirakina. Here he found the wreck of the vessel which Rossmuislov had been obliged to leave there in 1769 when he was on a voyage of exploration in Novaya Zemlya. The timber from the vessel was used by Pachtussov for building his winter house.

Societies and Academies

EDINBURGH

Royal Society, July 4.—**Eustace Barton-Wright and Alan McBain**: Studies in the physiology of the virus diseases of the potato. A comparison between the carbohydrate metabolism of normal and leaf-roll potatoes. An investigation into the formation of carbohydrates in healthy and leaf-roll potatoes at different times in the growing season. The nature of the translocatory sugars in healthy and diseased plants is also described and discussed.—**J. M. Robson**: Adrenaline and the œstrous cycle in the mouse. The subcutaneous injection of adrenaline hydrochloride into mature female mice inhibits the occurrence of œstrus; adrenaline also inhibits the development of sexual maturity when administered to immature female animals for prolonged periods. Vaginal cornification does not occur, and the growth of the vagina, uterus, and ovaries is less than in control animals. Evidence is presented suggesting that the action of the drug is not toxic in nature. Adrenaline does not interfere with the action of the α-hormone (œstrin) on the uterus and vagina. It does, however, interfere with the reactivity of the ovary to gonadotropic hormones (prepared from pregnancy urine).—**George Trapp**: The foliar endodermis of the Plantaginaceæ. The foliar endodermis is characteristic of the Plantaginaceæ. The Caspary strip is impervious to acid and basic dyes and probably also to ... The coincidence of mesophyll staining with endodermal absence or incompleteness in leaves of *P. arborescens* establishes this for acid dyes, while differential staining of Caspary strip region points to impermeability for basic dyes. Such a property is of value in the elaboration of root pressure. The aerial environment of the shoot reverses the direction of flow of solutes and renders functional interpretation impossible. The foliar endodermis is a feature of evolutionary inertia rather than of physiological necessity. —**A. G. Walker**: Relative co-ordinates. The elementary treatment of moving axes is extended to a general Riemannian space, a system of reference being defined at each point of a given curve. The elementary formulæ are generalised, and it is shown how the relative co-ordinates can be applied to a consideration of the geometry of the space in the neighbourhood of any given curve. As an example of application, the co-ordinates are used to discuss the kinematics of a rigid body in general relativity, the world line of one of the particles of the body being taken as the curve of reference. They also provide the formulæ used by Thomson in his work on rigid dynamics.—**John E. Mackenzie and Harry W. Melville**: The diffusion coefficients of bromine-hydrogen, bromine-nitrogen, bromine-oxygen, and bromine-carbon dioxide. The diffusion coefficients were measured by visual observation of the progress of diffusion of the highly coloured bromine vapour into a colourless gas contained in a long glass tube. The results obtained agree closely with those calculated from the theory of diffusion.

PARIS

Academy of Sciences, July 11 (vol. 195, pp. 85-192). —**Emmanuel Leclainche**: Notice on Bernhard Bang, *correspondant* for the Section of Rural Economy.—**Henri Lebesgue**: Notice on René Louis Baire, *correspondant* for the Section of Geometry.—**Maurice de Broglie and Louis Leprince-Ringuet**: The neutrons of boron excited by radium emanation. Whilst the rays from boron are absorbed at least as much by lead as by other bodies of equal thickness, the neutrons from boron pass much more easily through lead than through paraffin, the effect of 5 cm. of lead being scarcely perceptible.—**Léon Guillet, Marcel Ballay, and A. Le Thomas**: The influence of silicon on copper-nickel alloys containing small proportions of tin. Studies of a series of alloys with a fixed proportion of tin and increasing percentages of silicon, with special reference to the effect on the hardness at high temperatures.—**C. de La Vallée Poussin**: The properties of harmonic functions of two variables in an open area limited by particular lines.—**P. Vayssière**: Experimental observations on *Schistocerca gregaria*.—**Georges Giraud**: Certain operations on partial differentials of the parabolic type.—**A. Witt**: The stability of quasi-periodic movements.—**A. Lokchine**: The stability of a tube with curved axis.—**René Marty**: The calculation of helical springs loaded transversely.—**Emile Merlin**: The attraction between an ellipsoid and an external point.—**Sylvain Arend**: The normal anomaly and its rôle in two common astronomical applications.—**Y. Rocard**: The absorption of sound in tubes and acoustic mouthpieces. The nature of the wall of a tube through which sound is being propagated may cause loss through absorption. A modification of the classical equation (Lord Rayleigh, Webster) is suggested.—**Eligio Perucca**: The electrometer with semicircular sectors. This type of instrument is generally credited to Blondlot and Curie: it is pointed out that Morelli gave a complete theory of this instrument and described its practical realisation almost simultaneously with Blondlot and Curie.—**M. Pauthenier and R. Guillien**: The direct electrometric study of the limit charge of a conducting sphere in an ionised electrical field.—

Henri Abraham: The phenomena of synchronisation. A discussion of the conditions necessary for a wireless receiving apparatus to be in exact tune with the waves received.—**Pierre Girard** and **P. Abadie**: Experimental researches on the dispersion of polar liquids in the Hertzian field.—**P. Biquard** and **R. Lucas**: New optical properties of solids and liquids submitted to the action of ultra-sound waves.—**I. I. Agarbiceanu**: The intensities in the fluorescence spectrum of I_2.—**Joseph Giuntini**: α-Methoxy-β-hydroxysuccinic acid, its complex compounds with copper and their circular dichroism.—**B. Bogitch**: The separation of lead from zinc by the electrothermal method. For certain iron ores rich in lead and zinc the flotation method fails. Experiments with an electric furnace have given promising results.—**M. Bourguel, Mlle. B. Grédy**, and **L. Piaux**: Study of the *cis-trans* isomerism in the case of ethylene hydrocarbons of the formula $CH_3-CH=CH-R$. The eight hydrocarbons prepared have been studied from the point of view of the Raman spectrum.—**M. Haïssinsky**: The complex nature of the polonium ions.—**A. Lalande**: The turbidity surface of the system water-alcohol-ether at a low temperature.—**Georges Arditti**: The autoxidation of paraffin oil. A study of the amounts of fatty acids produced at a fixed temperature (130° C.) in the presence of various catalysts (Cu, Ni, CuO, NiO, Fe_2O_3).—**A. Travers** and **J. Aubert**: The variations of potential of electrolytic iron with the pH of the medium.—**Jean Cournot** and **Jean Challansonnet**: The action of molybdenum on the mechanical properties of grey cast iron. The mechanical properties of cast iron can be improved by the addition of molybdenum.—**Henri Fournier**: Attempts at stamping by the method of Siebel and Pomp.—**Francois Reymond** and **Tcheng Da-Tchang**: The reaction of precipitation by ammonia of the hydrofluoric acid solution of protactinium and of tantalum.—**A. Machebœuf, H. Cheftel**, and **J. Blass**: The colorimetric estimation of small quantities of lead introduced into food. The method outlined is suitable for determining quantities of lead between 0·15 mgm. and 0·25 mgm. to about 0·01 mgm.—**Jean Calvet**: The separation and determination of copper in the presence of aluminium by 8-hydroxyquinoline. Application to aluminium alloys.—**J. Guéron**: The slow hydrolysis of zinc acetate.—**Emilio Damour** and **Alexandre Nadel**: The diminution of the amount of iron in glass decolorised by selenium. In the decoloration of glass by selenium in presence of sodium chloride there is a partial volatilisation of the iron.—**R. Quelet**: The preparation of a chlormethyl derivative of p-bromanisol.—**Georges Corroy**: The Rhetian and the Hettangian in the east of the Paris basin.—**Fernand Daguin**: Stratigraphical observations on the region of Tissa (western Morocco).—**Edmond Saurin**: The Angaras to the east of southern Indo-China.—**J. Lombard** and **D. Schneegans**: The presence of the marine Eocene at Fouta (French Equatorial Africa).—**Paul Becquerel**: The dehiscence of the anther of the white lily.—**Antoine de Cugnac**: A new argument in favour of the hypothesis of a hybrid origin for *Bromus Gussonii*.—**André Dauphiné**: The properties of imbibition of collenchyma.—**Taboury**: The accidental presence of selenium in certain plants. It was shown in 1909 that selenium was present in the mineral springs at La Roche-Posay: selenium has now been found in *Sium latifolium* and in *Scrofularia aquatica* growing in the neighbourhood of these springs.—**Emile André** and **Kiawo Hou**: The lipoxydases of the seeds of *Glycine soja* and of *Phaseolus vulgaris*.—**Marc de Larambergue**: The absence of copulating apparatus in certain individuals of *Bullinus contortus*.—**Y. Le Grand**: The acuteness of the sense for variations of convergence.—**Neda Marinesco**: electric atmosphere o experimental proof of t on the flow of sap in the Study of the celluloses of A the Tunicata. These cellulos with cotton cellulose: chitin as forming part of the membr **W. S. Reich**: The synthetic p phosphoryl derivatives of the amino-a The considerable variations shown by of the maritime pine, *Pinus pinaster*, in power of the turpentine, and the relat of the rotatory power of the turpentine fro tree.—**Constantino Gorini**: The coagulation by *B. typhosus* and by other bacteria consid inactive towards milk.—**Pierre Lépine**: The s bility of the spermophile to exanthematic typhus.

CRACOW

Polish Academy of Science and Letters, April 11.—**K. Borsuk**: The isomorphism of functional spaces.—**W. J. Webber**: Certain properties of trigonometrical series presenting lacunæ. Note concerning a memoir of S. Banach.—**A. Jagielski**: The specific inductive capacity of liquid iodine. The S.I.C. of liquid iodine at 118° C. is 11·08, and increases with the temperature to 13 at 168° C.—**Wlad. Gorczyński**: A simple spectrograph and measurements of the absorption bands in the infra-red made in northern Africa in 1926–27.—**Wlad. Gorczyński** and **Ed. Stenz**: Atmospheric transmission in the ρ and Φ absorption bands of water vapour according to the spectrographic records of the solar spectrum made in Tunis in 1926–27.—**Ed. Stenz**: The absorption of water vapour in the solar infra-red, from spectrographic measurements made on the coast of the Mediterranean in 1931–32.—**Z. Kamecki**: Observations on the behaviour of the larvæ of Chrysopidæ and their faculty of finding their way by means of the senses.—**St. Skowron** and **T. Pawlas**: Observations concerning the action exerted by gonacrine on eggs and on the embryos of the rabbit.

VIENNA

Academy of Sciences, March 3.—**Gerhard Kirsch** and **Fritz Rieder**: Resonance of the beryllium nucleus. It has been recently shown by Curie and Joliot that the highly penetrating secondary radiation liberated from beryllium and boron by α-rays is able to set free, in substances containing hydrogen, a tertiary (H) radiation. The results of investigations on the tertiary radiation from various elements and of a consideration of the energy balance have led Chadwick to the conclusion that the penetrating secondary radiation is probably composed of neutrons of mass 1 and is not an electromagnetic wave radiation, as assumed by Curie and Joliot. Results are now given of experiments on the excitation of the secondary radiation in beryllium in relation to the energy of the exciting α-radiation, the tertiary H-radiation from hydrogen serving as indicator. These results appear to indicate the existence of resonance positions of the beryllium corresponding with residual ranges of the α-particles of 37 mm., 27 mm., and 15 mm. The assumption that the secondary radiation from beryllium comprises several components of varying hardness would furnish an explanation of the disagreement between absorption coefficient and maximum range of the tertiary protons noted by Curie and Joliot. The number of tertiary protons is extraordinarily high; if uniform distribution in space of the beryllium secondary radiation is assumed, the product of the efficiencies of the secondary and tertiary excitation process be about 3×10^{-8} for the resonance position co to the 27 mm. range.

Events

Ler ... hev ... ape ... at ... arsses

...m ... –Sept. 23

...in ... de ... DE DOCUMENTATION (Eleventh ... held at Frankfort-on-Main.

...and ...

...ke ... AUG. 31–Sept. 7

...ATION FOR THE ADVANCEMENT OF SCIENCE ... ING).

...ack ... Aug. 31.

...ach ... P.M. (at the Exhibition Hall).—Sir Alfred ...nis "An Engineer's Outlook" (Presidential Address ... of Exhibition Hall).

...day, Sept. 1.

At 10 A.M.—Dr. W. H. Mills: "Some Aspects of Stereochemistry" (Presidential Address to Section B).

The Right Hon. Lord Rothschild: "The Pioneer Work of the Systematist" (Presidential Address to Section D).

Prof. H. J. Fleure: "The Geographical Study of Society and World Problems" (Presidential Address to Section E).

Mr. T. B. Ponsonby: "A System of Forestry for the British Isles" (Chairman's Address to the Department of Forestry (K*) of Section K).

Prof. R. G. White: "Sheep Farming, a Distinctive Feature of British Agriculture" (Presidential Address to Section M).

At 2 P.M.—Lieut.-Col. Sir David Prain: "The Conservation of Wild Life" (Presidential Address to the Conference of Delegates of Corresponding Societies).

Friday, Sept. 2.

At 10 A.M.—Prof. A. O. Rankine: "Some Aspects of Applied Geophysics" (Presidential Address to Section A).

Prof. R. B. Forrester: "Britain's Access to Overseas Markets" (Presidential Address to Section F).

Prof. Miles Walker: "The Call to the Engineer and Scientist" (Presidential Address to Section G).

Dr. D. Randall-MacIver: "The Place of Archæology as a Science, and some Practical Problems in its Development" (Presidential Address to Section H).

Mr. W. M. Heller: "The Advancement of Science in Schools: its Magnitude, Direction and Sense" (Presidential Address to Section L).

At 8 P.M.—Sir Arthur W. Hill: "Plant Products of the Empire in Relation to Human Needs" (Evening Discourse in the Co-operative Hall).

Monday, Sept. 5.

At 10 A.M.—Prof. P. G. H. Boswell: "The Contacts of Geology: the Ice Age and Early Man in Britain" (Presidential Address to Section C).

Prof. Beatrice Edgell: "Current Constructive Theories in Psychology" (Presidential Address to Section J).

Prof. J. H. Priestley: "The Growing Tree" (Presidential Address to Section K).

At 5.30 P.M.—Mr. H. E. Wimperis: "Speed in Flight" (Public Lecture in the Co-operative Hall).

At 8 P.M.—Sir Richard Gregory, Sir Harold B. Hartley, Mr. Donald Gray, Dr. W. W. Vaughan, Prof. W. W. Watts, Mr. W. M. Heller: Discussion on "The Place of Science in the Education of Boys and Girls up to Sixteen Years of Age".

Tuesday, Sept. 6.

At 8 P.M.—Mr. C. C. Paterson: "Uses of the Photoelectric Cell" (Evening Discourse in the Co-operative Hall).

Official Publications Received

BRITISH

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1377 (T. 3026): Application of Goldstein's Airscrew Theory to Design. By C. N. H. Lock. Pp. 24+4 plates. (London: H.M. Stationery Office.) 1s. 3d. net.

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1931 May 19—1932 May 18. Pp. 4. (Cambridge.)

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 13: January, February, March 1932. By Ernest A. Hodgson. Pp. 211-224. (Ottawa: F. A. Acland.) 25 cents.

The Journal of the Institute of Metals. Vol. 48. Edited by G. Shaw Scott. Pp. xi+350+33 plates. (London: Institute of Metals.) 31s. 6d. net.

Indian Journal of Physics, Vol. 7, Part 2, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 16, Part 2. Conducted by Sir C. V. Raman. Pp. 107-164. (Calcutta.) 1.8 rupees; 2s.

Mysore Geological Department. Bulletin No. 12: Mineral Survey of the Sulphide Zone near Chitaldrug. By B. Rama Rao. Pp. iv+40+8 plates. (Bangalore: Government Press.) 1 rupee.

India: Meteorological Department. Meteorological Organisation in India for the Supply of Weather Information to Aviators. Pp. iii+27. 12 annas; 1s. 3d. Scientific Notes, Vol. 4, No. 41: The Sea-Breeze at Karachi. By Dr. L. A. Ramdas. Pp. ii+115-124+10 plates. 1.8 rupees; 2s. 6d. (Calcutta: Government of India Central Publication Branch.)

Proceedings of the South London Entomological and Natural History Society, 1931-1932. Pp. xx+116+11 plates. (London.) 12s. 6d.

Report of the Director of the Royal Observatory, Hong Kong, for the Year 1931. Pp. 23. (Hong Kong.)

Annual Report of the Auckland Institute and Museum for 1931-32, adopted at the Annual General Meeting held on 25th May 1932. Pp. 51. (Auckland, N.Z.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (New Series), No. 6, June. Abstracts Nos. 984-1178. Pp. 177-214. (London: H.M. Stationery Office.) 1s. net.

Annals of the Solar Physics Observatory, Cambridge. Vol. 2, Part 2: Stellar Hydrogen Line Contours and their Variation with Temperature and Surface Gravity. By E. G. Williams, under the direction of F. J. M. Stratton. Pp. 19-47+plate 4. (Cambridge: At the University Press.)

Royal Agricultural College Students' Gazette. New Series, Vol. 19, Part 1. Pp. 184. (Cirencester.) 1s.

Proceedings of the Society for Psychical Research. Part 126, Vol. 41, July. Pp. 59. (London: Society for Psychical Research.) 4s.

The Sir John Cass Technical Institute. Report of the Governing Body for the Session 1930-1931. Pp. 31. (London.)

Proceedings of the Cambridge Philosophical Society. Vol. 28, Part 3, 30 July. Pp. 257-402. (Cambridge: At the University Press.) 7s. 6d. net.

London School of Hygiene and Tropical Medicine (University of London). Post-Graduate Instruction in Preventive Medicine. Pp. 32. (London.)

University of Birmingham: Executive Board of Mining Research. Report on the Work of the Mining Research Laboratory during the Year 1931. Pp. 20. (Birmingham.)

FOREIGN

Smithsonian Institution: Bureau of American Ethnology. Bulletin 94: Tobacco among the Karuk Indians of California. By John P. Harrington. Pp. xxxvi+284+36 plates. 80 cents. Bulletin 102: Menominee Music. By Frances Densmore. Pp. xxii+230+27 plates. 80 cents. Bulletin 104: A Survey of Prehistoric Sites in the Region of Flagstaff, Arizona. By Harold S. Cotton. Pp. vii+69+10 plates. 30 cents. (Washington, D.C.: Government Printing Office.)

Instituto Geográfico, Catastral y de Estadística. Anuario del Observatorio Astronómico de Madrid para 1932. Pp. 540. (Madrid.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 370-372: X-Ray Diffractions by Volcanic Glasses and Ashes, by Morisô Hirata; Hyperfine Structure of Lead Spectrum, II, by Kiyoshi Murakawa; Photoelectric Effect of L_{III}- and L_{III}-Electrons for γ-Rays, by Toshinosuke Muto. Pp. 237-298. (Tōkyō: Iwanami Shoten.) 65 sen.

Annuario della Reale Accademia d' Italia. III, 1930-1931, Anno 9. Pp. 364. (Roma.)

National Research Council. Transactions of the American Geophysical Union, Thirteenth Annual Meeting, April 28 and 29, 1932, Washington, D.C. Pp. 401. (Washington, D.C.: National Academy of Sciences.)

Société des Nations: League of Nations. Index translationum: Répertoire International des Traductions: International Bibliography of Translations. No. 1, Juillet. Pp. 58. (Paris: Institut International de Coopération Intellectuelle.) 7.50 francs.

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 28, Part 2: The American Species of Thibaudieae. By Albert C. Smith. Pp. vii+311-547+ix-xiii+19 plates. (Washington, D.C.: Government Printing Office.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 8, No. 6, June, Research Papers Nos. 446-452. Pp. 669-811. (Washington, D.C.: Government Printing Office.)

Proceedings of the American Philosophical Society. Vol. 71, No. 4. Pp. 185-223. (Philadelphia.)

Journal of the College of Agriculture, Imperial University of Tokyo. Vol. 11, No. 4, June 30th. Pp. 359-439. (Tokyo: Maruzen Co., Ltd.) 1.20 yen.

Tanganyika Territory: Geological Survey Department. Bulletin No. 3: Lupa Goldfield. By Dr. D. R. Grantham. Pp. ii+84. (Dar es Salaam: Government Printer.) 5s.

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NATURE

SATURDAY, SEPTEMBER 3, 1932

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The Contribution

THE return of the scene of its first m suggest interesting compar tion of science in 1831 and connexion it is not inappropria should occupy the presidential ch years ago the nation was still in the industrial revolution and the economi which followed the Napoleonic wars. I and inventions in mechanical science had found application in industry and were prod revolutionary changes in society. The whole stru ture of industry was being changed ; old industries hitherto carried on in the homes were being swept into the mills and factories and new industries had been created. The railway and steamship age was just opening, and was indeed fostered by some of the researches promoted by the Association. Faraday had already made the fundamental discovery which later bore fruit in the dynamo and all the myriad ramifications of the electrical industries.

Much of the unrest of this period was due, however, to the indifference to the social or human consequences with which mechanical and other scientific discoveries had been applied in industry. At the time when the British Association held its first meeting at York, the human aspects of the industrial revolution were just beginning to receive attention, and the movement which a decade later led to the passing of the Factory Acts was then being initiated by Lord Shaftesbury. There is perhaps nothing upon which scientific workers, whether engineers or not, are entitled to look back with more justifiable pride than the steady rise in the ethical standards of the industrial community wherever science has influenced its activities. In 1831 it is fair to say that little trace could be found of the scientific spirit in industry. The discoveries of science had been applied to industry with as much indifference to science as to humanity. During the following century, however, science brought the spirit of service into competition with the desire for private gain, and the perversion of the gifts of science to the exploitation of those least able look after themselves became less and less tol either to the industrial community or to a whole.

In this tendency, the tradition of the service of mankind should al advance

al of public service. ...ic spirit as involving ...y can be traced in the ...itution of Civil Engineers ...as in that of the Federated ...ng Societies. This change in ...stry has affected even economic ...has come to acknowledge that co- ...a nobler ideal than self-interest; and ... could easily be multiplied to show that ...try becomes more widely influenced by ... the obligation to subordinate self-seeking ...e common good becomes more widely acknow-...dged.

The transformation in the ethics of a large section of industry would alone be sufficient to explain the attention directed at the present time to the social consequences of the new industrial revolution. This new industrial revolution has emerged from that of the early nineteenth century so gradually that it is only in the last few years that its fundamental characteristic has been clearly perceived—the substitution of other powers for human physical effort as the working energy of the world's production. The acute reaction on employment of the immense increase in the productive capacity of mankind made possible by science has at last brought us to see that science has given us to-day a new kind of production. Power production embodies a profound and vital change in the relation of human labour to the processes and products of the world's work. Not merely in industry but also in agriculture and in transport, not merely with regard to manual labour but also in regard to clerical work, those greater resources of power and fuller control over the forces of Nature are enabling man to do more with less effort. The mechanical invasion of mankind is still only in its initial stages. More and more the function of labour becomes that of admitting power to the machine and manipulating power controls. The intelligence and responsibility hitherto known as skill in craftsmanship are either displaced or concentrated in a small central staff of experts.

These two significant facts—that output in pro-...tion has escaped from the limitations imposed ...man physical energy, and that actual pro-... to-day is indeed only a fraction of what it ...f the existing plant were worked to full ...rt altogether from the prospect of ...sation in the of... ...s well as in ...orced soci... ...que... ...nk...

in particular must face those consequences and be increasingly concerned with the moral and social results of their work. The future of civilisation itself depends less upon the increasing powers which scientific discoveries and their application have placed in the hands of men than upon the way in which these powers are used.

The existence of world-wide unemployment and poverty, the sinister shrinking of international trade, side by side with this greater productive power, more abundant crops, and fuller control over Nature have suggested to many that the old objection of the manual worker to machinery is not without foundation. It is useless for the scientific worker to provide the greater productive powers or even more effective ways of protecting crops unless society has an economic and social organisation which provides the appropriate seeds, fertilisers, tools, etc., and cultivators capable of understanding their use. This presupposes some developed system of industry, transport, distribution, and education, in which the cultivator and the inventor can both be fostered. The immense complexity of modern pure and applied science requires a corresponding complex social organisation.

When, however, we turn from the sphere of production to that of commerce and distribution, we enter a world of crude empiricism, secrecy, and mystification into which scientific method or principles have yet to permeate, and exact knowledge and its free interchange is almost totally absent. Our distributive and economic system remains on the basis of a pre-scientific era, wholly unadjusted to the change, and unable to bear the burdens placed upon it by this problem of new and almost incredible abundance. Adjustment is called for and can only be effective when the spirit and methods of science are freely applied in this sphere also, and it is recognised that the new powers involve the release of the general human life from Nature's old exaction of drudgery for a mere pittance. The release into an enlarged and enriched leisure for all men for general human culture would appear to be the only alternative to chronic unemployment.

It is thus not machinery that is at fault but the abuse of the powers which machinery has given to mankind, through mistakes in the economic and political sphere. The application of scientific methods in the fields of distribution and finance ha... scarcely bee...

to the far-flung factories and communications of the modern world. Machinery, the product of scientific knowledge, can only be controlled by greater knowledge, more widely understood and thoroughly applied. The mistakes in our economic, financial, and distributive systems can only be corrected by the application in these fields of the same scientific logic and strict submission to fact and impartial deduction which have given us the machines.

The contribution of science to these interwoven problems of leisure and distribution is not limited to the impartial examination of problems of finance and distribution. There are also required those qualities of mind which collectively make up the spirit of science—the readiness to face change or adopt new outlooks, theories, or hypotheses, the habits of accurate observation, collection, and arrangement of all relevant facts, the willingness to experiment, the power to formulate hypotheses and to use and test them as tools, not as creeds. These are qualities and habits which cannot be acquired or practised without sincerity of purpose, honesty of thought, and open-mindedness, and it is these, as well as the imagination which the scientific investigator must also possess, that are needed if we are to solve the problems of leisure and distribution. If it is true, as General Smuts pleads, that we need the cool, serious, gentle spirit of science in human affairs, and that the application of the true scientific spirit would make possible such a reign of justice and fair play on earth as only poets have dreamt of, it is also true that without the quality of imagination there can be no inspiring vision, no rising out of the common ruts of thought, either in science, in art, or in religion. The greatest men of science in every age have been men of vision possessed of imaginative powers which enabled their thoughts to pierce through the clouds of ignorance and uncertainty and discover some clue to the truth upon which their experimental genius and critical judgment could later be brought to bear.

There is much about us to suggest that the inspiration of such examples is one of the most important contributions that science can make to the solution of the common problems of humanity to-day. Not merely the technique of scientific method for ascertaining the relevant and undistorted facts upon which effective action must be based, not merely the spirit of adventure and the willingness to face change and to try new methods, essential as they are in the dynamic order of society which science has created, but also the vision of a new order of society in which man has quietly and confidently evolved the powers demanded of him for planning intelligently and co-operating efficiently on an international scale in the utilisation of the abundant resources of the world. As Prof. L. P. Jacks recently reminded us, " a race which emerged from the ignorance and brutality of barbaric ages is quite capable of emerging from mechanisation and standardisation, and will emerge if brave men stand to it ".

Scientific methods offer us a surer hope of the solution of our modern problems than the financial, economic, or commercial considerations which have so long dictated policy. It would be unwise, however, to assert that science alone would be sufficient. Science can assist in the discovery of the right ways for the use of the new powers with which it has endowed mankind, but the endeavours of science to make the world a better place to live in and to help men to be worthier of the splendid possibilities of life will be largely defeated unless there can be brought to bear the moral power which ensures the rightful use of those new powers. To the scientific mind and energy which patiently and impartially sorts out the facts of life there must be joined a sense of values, a moral purpose, and a vision of order and beauty competent to compel action upon the ascertained facts for the ordered development of mankind.

Overshadowed by the financial and political events of last autumn, the centenary meetings of the British Association did not receive their normal share of public attention, but the wise words of the presidential address may well come to be regarded as prophetic by many by whom at the time they were unheeded: " Among the human values thus created science ranks with art and religion. In its selfless pursuit of truth, in its vision of order and beauty, it partakes of the quality of both. More and more it is beginning to make a profound æsthetic and religious appeal to thinking people. . . . One of the gravest tasks before the human race will be to link up science with ethical values and thus to remove grave dangers affecting our future. . . . Science may be destined to become the most effective drive towards ethical values, and in that way to render its most priceless service." As the spiritual development of mankind comes once more in step with material progress, it will be possible for the combined moral, ethical, and scientific forces to build up a well-balanced civilisation from which disease, poverty, and war have been eliminated and men strive only to excel in the service they render, the contribution they offer to the common weal.

Mathematics and Astronomy of the Ancient Jewish Rabbis

Rabbinical Mathematics and Astronomy. By Dr. W. M. Feldman. Pp. xviii + 232. (London: M. L. Cailingold, 1931.) 10*s.* net.

WESTERN civilisation is largely based upon three influences emanating from Mediterranean shores—Hebrew, Greek, and Roman. While the legacy of Rome and the legacy of Greece have been gaining in appreciation in Western literature and thought, there has been a tendency to belittle the Hebraic influences. Things Jewish are almost always subject to exaggeration. There is a prevalent tendency (practically non-existent, however, in Great Britain) to attribute to Jewry the blame for every evil for which a more convenient scapegoat cannot be found, and this sometimes produces, in return, an exaggerated estimate of Jewish virtue and genius. Much that is written about Jews is either accusation or apology, a fact that has to be borne in mind in connexion with a publication like that which forms the basis of the present notice. Anybody writing about rabbinical science is tempted either to find merit where it does not exist or to overlook it where it does exist.

It is, therefore, all the more remarkable that Dr. Feldman, while being neither a professional rabbinical scholar nor a specialist in the exact sciences, has produced this volume, in which, on the whole, the tendency referred to is held in check. That the author has not been entirely successful in this regard indicates the difficulty of being completely objective. In some places it is also due to the author's limitations, both on the rabbinical and on the mathematical and astronomical sides.

Of what interest can it be to us to know how much mathematics and astronomy the Rabbis of the Talmud possessed? It is surely a fact that rabbinical influence upon the advance of the sciences was practically nil, and that, although the Jews in the Middle Ages were as important as the Arabs in the carrying on of the tradition of learning, especially in mathematics, astronomy, and medicine, nevertheless, this function was not due to talmudical influence, but to the Jewish love for learning from any source and for its own sake.

The answer is that it is of some importance, especially to Jews, but also to non-Jews, to understand clearly what have been the main currents of thought in Jewry during the various periods through which it has passed. The fact that the great Jewish thinkers of two thousand years ago are not known to have discovered any important scientific facts or devised any important scientific theories, and were, indeed, not even fully acquainted with what had been discovered by their Greek contemporaries; that, during the Middle Ages, the Jews shared with the Arabs the task of keeping scientific learning alive and fostering its growth; and that, in modern times, the Jews have occupied a place of ever-growing importance in scientific discovery—represents a significant piece of information that should throw light upon the nature of racial and national reaction to intellectual influences.

Dr. Feldman's book attempts to cater both for the scientific worker who knows nothing about the rabbinical life of the Jews and for the Jew who knows nothing about mathematics and astronomy. Perhaps he would have done better to quote frankly any mathematical and astronomical results needed for his book, without attempting to prove them. He sometimes gets lost in the mathematics, and in at least one place his knowledge of astronomy is faulty, namely, where he tries to explain Kepler's laws—which are, indeed, irrelevant to the main object of the book.

Dr. Feldman has also in several places departed from complete objectivity. He claims that, in rabbinic times, the Jewish calendar involved just such complicated calculations as he himself gives in his book. It is fairly certain that nothing of the kind really happened, and that the Rabbis of two thousand years ago used rule-of-thumb methods and very rough calculations in order to deal with the calendar. The Jewish calendar is, in fact, so rough an approximation that, while it represents a creditable performance for the Rabbis of the fourth century, it cannot, nevertheless, claim to have anything to do with evection and parallax, variation and secular acceleration.

The author has, however, avoided some of the traps into which other writers have fallen. He does not mistranslate a famous talmudical paragraph, in order to prove that the Rabbis of the Talmud believed in the Copernican system of the planets. He does not suggest that Rabbi Joshua in the first century A.D. knew about Halley's comet, although he claims that a periodic comet was known to this Rabbi. On the other hand, he strains the text in some places, especially when he refers to a 'tube' used by Rabbon Gamliel in the first century as being a telescope or an astrolabe. There is little in the talmudical text to indicate the nature of this tube, but there certainly is no reason to suppose any anticipation of Galileo. What little there is in the text suggests a round tube with one end open, the other end being provided

with a peephole. Probably the length of the tube, divided by the width of the open end, was used as the ratio of a distant object seen to occupy the diameter of the open end, divided by the size of the object. By using some standard object, like an average-sized palm tree, the tube could be adjusted for some fixed distance.

The general conclusion of the author is to assign some merit to the Rabbis in astronomy, but comparatively little in mathematics, except in so far as they were able to apply elementary mathematical theorems to various practical purposes. In a preface, Prof. R. A. Sampson says of the Jews " of the past ages " :

" they are interested in subtleties it is true, especially the subtleties of the Law, but not in those of Mathematics, nor of any natural science in which tradition counts for nothing. The regulation of the traditional Calendar forced upon them certain astronomical calculations which were competently performed, but the treatment, as any mathematician can see, is such as would lead to no advance."

This is probably a fair summing up of the situation, although it must be added that a more intimate study of the vast material available, and not dealt with in the present work, tends to prove that the Rabbis knew more and reasoned more scientifically than appears from Dr. Feldman's book. The book can be recommended to anybody who is interested in the scientific history of a unique people that has passed through unprecedented adventures and evolutions. S. B.

Pests of the Countryside

Beasts and Birds as Farm Pests. By Prof. James Ritchie. Pp. xii + 270. (Edinburgh and London : Oliver and Boyd, 1931.) 12*s.* 6*d.* net.

A THOROUGHLY useful book by an expert naturalist, dealing with mammals and birds as useful or injurious to British agricultural operations, and holding the scales fairly and evenly. Nature, if left alone, strikes a working balance between every animal and its natural enemies, but man's unconscious efforts usually load one scale. The nature of the agriculture is an important matter. Starlings, for example, " do great service in a pastoral country, in a corn-growing land they do great damage ". We hate them among our fruit, but it is possible that they, like many other ' pests ', are, on a balance, really beneficial on account of the vast numbers of slugs, snails, and insects they consume. Certainly we would suppose that stoats and weasels, so hated by the gamekeeper, by their destruction of rats, mice, and even rabbits, save stored corn and growing crops of many times the value of the occasional poultry that they kill.

The house sparrow is, of course, an unmitigated nuisance, and its annual damage is put at the very low figure of £8,000,000. Still worse are the rats, which, if estimated as equal in numbers to man in Great Britain and each doing damage of a penny a week, present a bill of £10,000,000—an estimate surely many times too small. Further, the author refers to brown rats as carriers of influenza, foot-and-mouth disease, and trichinosis, and the last disease and also dysentery may be carried to man. The black rat with its associated fleas are responsible for the spread of bubonic and pneumonic plagues. This may become a serious matter, for the black rat is a climber which might wander from house to house on our aerial networks, so that the new concrete building that clears our basements of brown rats would be of no avail. At any time this question of rats and mice might well become of great importance to public health, and it behoves us to inquire how far the provisions of the Rats and Mice (Destruction) Act of 1919 have been made effective in Great Britain. Assuredly, rats can only be lessened substantially in numbers by collective action.

Farmers may reduce most pests in their neighbourhood and even secure the desirable balance on their farms. Prof. Ritchie tells them how to combat their enemies—mammals interfering with stock, injurious to crops, wasting woodland, and destructive to stored grain. Birds are even more important and bulk larger in his consideration of the matter, all the evidence being summarised and critically and intelligently examined. This is just what is wanted, and the result is a most valuable work of reference and a guide to the practical man who uses his wits. It may be necessary to thin the stock of any bird in any ecological environment, but it is doubtful whether it would be wise policy to carry this out in any part of England to the extent to which it appears to be done in France.

The author coming from north of the Border, we naturally looked for a full account of that major pest, the American musk-rat, which is already widely distributed over Scotland and England. Here, as in the case of the grey squirrel and the little owl, the introduction was unintentional, and Prof. Ritchie truly states that " the worst pests in any country are, as a rule, creatures which have been introduced, accidentally or deliberately, from other places ". The musk-rat was introduced into Central Europe about 1905 and has become a major pest that exercises the government of every country

there. Its skins are now exported to North America and are no longer leaders in fashionable furs. Brought to England since the War, we now have scores of centres where the musk-rat breeds. They do not, perhaps, do much direct harm to the farmer's crops, but the prosperity of a large part of our agricultural population depends on the safety of the waterways, the banks of which they riddle with their burrowings. It is folly for the government of any civilised country not to use the knowledge that science has accumulated, and assuredly any body of competent zoologists could have foretold the years of unrelaxed efforts and vast expense to which we are now doomed (see "The Musk Rat Menace", by Martin A. C. Hinton, *Natural History Magazine*, April 1932, 177-184).

The Destructive Imported Animals Act, 1932, has come too late for the musk-rat, but we may inquire as to the competence of the machinery which it presumably sets up. Animals are so varied that no civil servant can know all, and it might be wise for any Government department concerned with animal importations, for pleasure or profit, to ask advice of the experts in the British Museum and of animal science as represented in the Royal Society. We are sure that neither body would neglect to seek the opinions of the author of the valuable volume now before us.

Quantum Theory.

(1) *The Theory of Groups and Quantum Mechanics.* By Prof. Hermann Weyl. Translated from the second (revised) German edition by Prof. H. P. Robertson. Pp. xxii + 422. (London: Methuen and Co., Ltd., 1931.) 21*s*. net.

(2) *L'Atome de Bohr: la mécanique analytique et les quanta, les spectres de multiplets.* Par Prof. Léon Brillouin. (Recueil des Conférences-Rapports de documentation sur la Physique.) La théorie des quanta. Deuxième édition. Pp. 363. (Paris: Les Presses universitaires de France, 1931.) 100 francs.

(3) *The Physical Significance of the Quantum Theory.* By Prof. F. A. Lindemann. Pp. vii + 148. (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 7*s*. 6*d*. net.

(1) AN English edition of Prof. H. Weyl's well-known book is very welcome; the book remains a difficult one to read, but to anyone with an imperfect knowledge of German the task will be considerably lightened by the translation. The translation has been made from the second German edition, which differs from the first in that certain chapters, notably Chap. v., which originally were more condensed and harder to understand than the rest of the book, have been rewritten in a simpler way. Also in the third chapter, in which group theory is first introduced, an example, namely, the Clebsch-Gordan series, is given of a group and of its reduction. Another welcome addition is a discussion of the Heisenberg-Pauli theory of the quantisation of the radiation field, which has appeared since the first edition of Prof. Weyl's book.

It has been rumoured, as Prof. Weyl admits in his introduction, that the 'group pest' is disappearing from theoretical physics. It is certainly true that, thanks to the work of Slater, Bloch, and others, the chief applications of quantum theory to spectroscopy and chemistry can be understood without mastering the notation of group theory. It is probable that group theory will in the future prove more useful in other fields, as, for example, in the search for a satisfactory synthesis of relativity and quantum mechanics. To anyone hoping to embark on such a task, or wishing to understand the work already done in this field, Prof. Weyl's book does not need recommendation.

(2) To the future student of the history of theoretical physics, Prof. Brillouin's book will be invaluable; for it expounds, with the lucidity and elegance that one expects from a Frenchman, the Bohr-Sommerfeld theory of the quantisation of orbits, as it was in 1924, before its methods finally gave place to those of the new mechanics. Some 140 pages are devoted to relativity, electromagnetism, and general dynamical theory; the Bohr-Sommerfeld theory occupies the rest of the book.

The book is theoretical, there being no description of experiments. Such matters as Zeeman effect, multiplets, relativity correction, and spinning electron are dealt with. There is a detailed discussion of the theory of penetrating orbits, showing the very rough agreement with experiment that could be obtained with the old theory. Nothing but praise can be given to the way in which the subject matter is presented; the reviewer would only question whether it was worth while to write such a detailed account of a physical theory which is now largely superseded.

(3) Prof. Lindemann's book is an attempt to show that some results of the wave mechanics, such as the exclusion principle and the quantisation of energy, are consequences of the Heisenberg uncertainty principle and of the resultant failure of the spatio-temporal description of physical phenomena. In the opinion of the reviewer, the attempt is not successful, because, although the author makes

it appear plausible that some kind of quantisation results from the uncertainty principle, he does not attempt to deduce Schrödinger's equation. It is surely of little use to attempt to explain such a phenomenon as quantisation, unless one can shed light on the origins of the equation from which the exact values of the energy levels can be deduced. N. F. M.

Short Reviews

A Handbook of Child Psychology. By John E. Anderson, Charlotte Bühler, Anna Freud, Arnold Gesell, Florence Goodenough, Leta S. Hollingworth, Susan Isaacs, Harold Ellis Jones, Mary Cover Jones, Vernon Jones, C. W. Kimmins, Heinrich Klüver, Kurt Lewin, Helen Marshall, Dorothea McCarthy, Margaret Mead, Joseph Peterson, Jean Piaget, Rudolf Pintner, Lewis M. Terman, Beth L. Wellman, Helen T. Woolley. Edited by Carl Murchison. (The International University Series in Psychology.) Pp. xiii + 711. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1931.) 22*s.* 6*d.* net.

THE subject of child psychology is really a very old one, although the interest displayed in it by so many psychologists, medical men and lay persons, is very largely a post-War phenomenon. Prof. Carl Murchison presents us with an extremely varied and well-balanced selection of papers by authorities on problems of child psychology the world over. In his preface he mentions the omission of a chapter on the delinquent child and calls for discussion. It is admittedly difficult to deal adequately with delinquency in children in a single chapter, but we think that the subject belongs very much more to the realm of psychology than to that of sociology. One has only to read Burt's " Young Delinquent " to realise the wide ramifications of delinquency when regarded as a psychological problem. We would very much welcome two or even three chapters devoted to delinquency in the next edition. The chapter devoted to eating, sleeping, and elimination is well done but seems rather long. The chapters by such authorities as Piaget and Bühler need no recommendation, since they are typical of the high standard one expects.

Mechanical Testing: a Treatise in Two Volumes. By R. G. Batson and J. H. Hyde. (The Directly-Useful Technical Series.) Vol. 1: *Testing of Materials of Construction.* Second and enlarged edition. Pp. xv + 465 + 68 plates. (London: Chapman and Hall, Ltd., 1931.) 21*s.* net.

SINCE the first issue, just ten years ago, of the admirable treatise by Messrs. Batson and Hyde on the testing of constructional materials, notable developments have taken place, particularly in regard to the standardisation of methods of testing. The British Standards Institution has issued a number of important specifications, and advantage has been taken of the opportunity afforded by a second edition of the book to incorporate in full measure the Institution's requirements. The chapters on fatigue testing, hardness testing, and testing at high temperatures have been enlarged in order to record the rapid progress made in these branches of work. These and other additions and emendations enhance the value of a work which has already gained a well-merited degree of popularity among students and experts alike. B. C.

Co-operation in Danish Agriculture. By Harald Faber. An English adaptation of " Andelsbevægelsen i Danmark " by H. Hertel. New edition. Pp. xxii + 188. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 9*s.* net.

IT is not surprising that the first edition of Mr. Faber's excellent book is exhausted and that a second edition should be called for. In this he has embodied the results collected by Mr. Hertel and published in 1929, so that he has been able to bring his information up to date; he has also incorporated material from recent official statistical publications in Denmark. The book appears at an opportune moment, when the agricultural policy of Great Britain is being seriously reconsidered, and when the co-operative methods which have done so much for Denmark are being studied with the view of seeing if they would not prove equally helpful here, at any rate with appropriate modifications. Mr. Faber's account is authoritative, lucid, and impartial; the book can be commended to all students of agricultural problems.

Le problème de l'évolution. Par Prof. Maurice Caullery. (Bibliothèque scientifique.) Pp. 448. (Paris: Payot et Cie, 1931.) 40 francs.

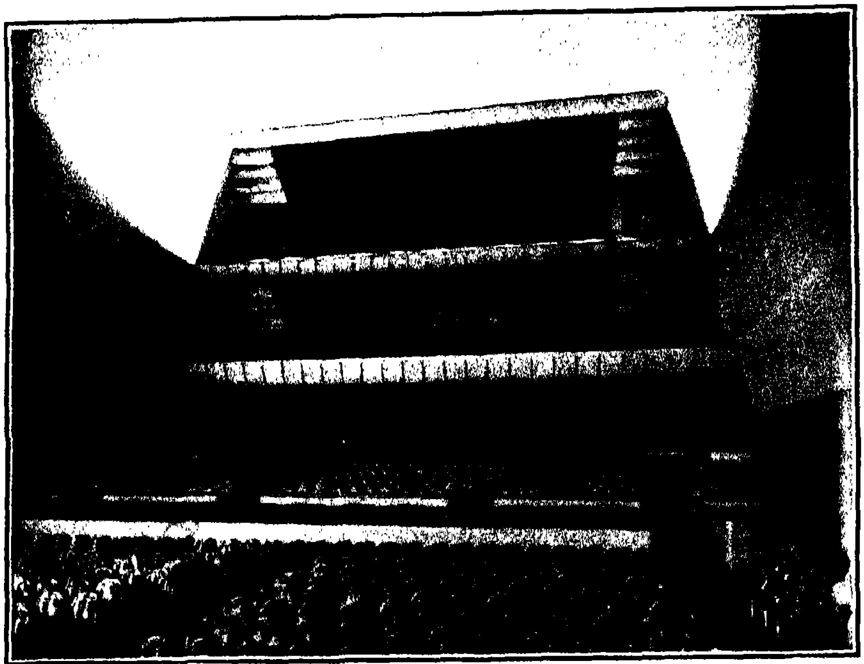
IN this excellent work, the author covers, in just over four hundred pages, all the fundamental landmarks and theories of the epic of evolution. The first part of the book is mainly devoted to a discussion of the palæontological discoveries supporting evolution, while the second part explains and criticises the various theories put forward to explain evolution. The author is not entirely satisfied with mechanism, and mentions the doctrine of emergence as offering a suggestive ground for reconciling facts and theories. Yet he does not find it wise, at the present state of our knowledge, to venture into dogmatic assertions about the final value of evolution. T. G.

Conditions and Consequences of Human Variability. By Prof. Raymond Dodge. Published on the Louis Stern Memorial Fund. Pp. xi + 162. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1931.) 11*s.* 6*d.* net.

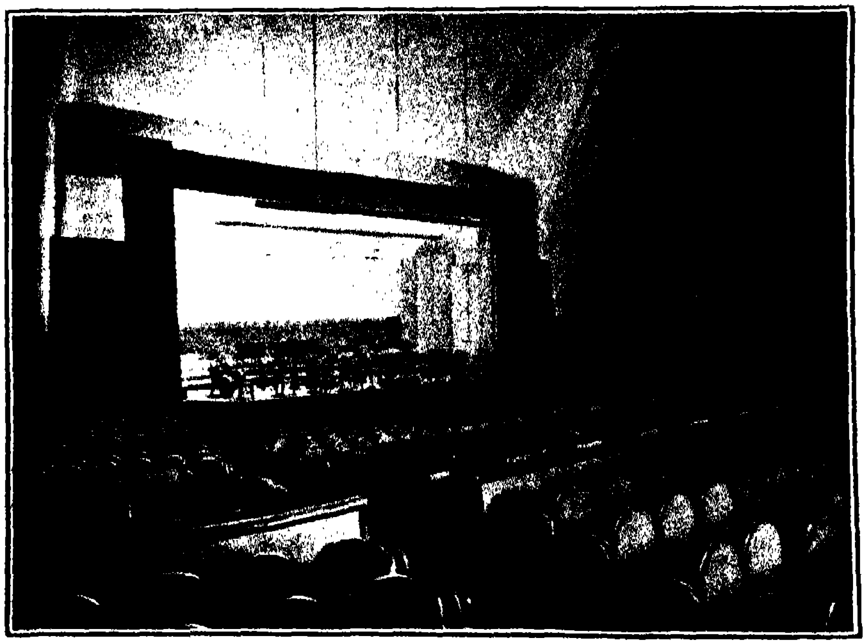
PROF. DODGE has discussed the significance of variability of mental development. The author groups himself amongst the supporters of the *Gestalt* movement: he calls himself a " behaviouristic Gestalt ". He is not satisfied with psycho-physical parallelism, and puts forward his hypothesis of apperceptive integration, that is, an integration which would approximately result in consciousness and which takes place in the brain.

The Salle Pleyel, Paris, and Architectural Acoustics

THE meetings of the Second International Congress of Electricity, recently held in Paris, took place in the great building newly constructed by the Pleyel Company in the faubourg Saint Honoré, and there are probably few among those present who were not impressed by the faultless acoustics both of the Great Hall, where the inaugural and other meetings were held, and of the so-called *Salle Chopin*, where the meetings of Section 1, devoted to pure physics, occurred. The Great Hall can accommodate some three thousand auditors, and yet, as the present writer proved, a speaker reading from a paper in the ordinary tone of a lecturer in a small class-room can be heard perfectly in various parts of the hall, including the back of the upper gallery, more than fifty yards away. The principles upon which this hall was designed by M. Gustave Lyon are very simple, but there is no doubt as to their efficacy in this and other examples of his work.



Photo] FIG. 1.—Auditorium of the Salle Pleyel, seen from the stage. [Chevojon.



Photo] FIG. 2.—Stage of the Salle Pleyel, seen from about the middle of the parterre. [Chevojon.

The reflections which take place at the walls of a hall are absolutely necessary for good hearing, since without reinforcement of this kind a normal speaking voice is inaudible at a very short distance. A curious experiment was carried out by M. Lyon on this point at Challais-Meudon. Two observers were suspended by cords below small balloons, which could be manœuvred to any desired distance apart, and it was found that, under such conditions, the speaking voice was quite inaudible at a distance of 11 metres. Similar results have been obtained on plains covered with soft new-fallen snow, which is a very bad reflector of sound, while, on the other hand, on perfectly smooth water at night a normal voice can be heard at a distance of more than a mile. Reflections are, then, indispensable.

On the other hand, if the interval between the reception of the direct and of the reflected sound is too large, an unpleasant effect is produced which with increasing interval soon resolves itself into

two distinct sounds. Estimates of the maximum permissible interval naturally vary somewhat. According to Ernst Petzold, it should not exceed $\frac{1}{20}$ sec. M. Lyon has carried out extensive experiments with trained musicians as his collaborators, and finds that a slightly longer interval may be

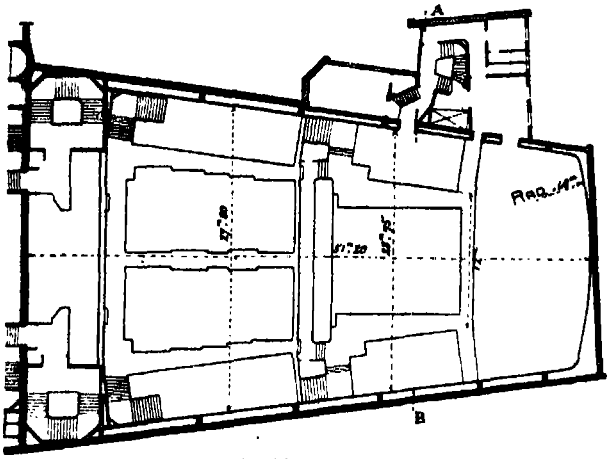


FIG. 3.—Plan of the hall.

allowed in practice. The least permissible interval is greater with such sounds as those of an orchestra than with staccato sounds, such as the noise of castanets or of an actor dying in the prescribed mode, and appears to run up to $\frac{1}{10}$ sec. for the former, but not to exceed $\frac{1}{15}$ sec. for the latter. In any event, $\frac{1}{15}$ sec., or, expressed as sound path, 23 metres, may be taken as a practical limit to which to work. This at once restricts the depth of the stage to 11 metres, if good reflection from the back wall is taking place, and, for the sake of listeners to one side, the breadth to 23 metres, if the whole stage is to be occupied by, for example, an orchestra. The stage in the *Salle Pleyel* is actually about 20 metres wide by 10 metres deep.

A hall is bounded by floor, ceiling, wall at back of stage (which we will call stage wall), side walls, and wall opposite stage (which we will call back wall). Any hall for a large audience will be much more than 11 metres long, which means that any echo from the back will make, for people near the stage, more than the permissible interval with the direct sound. Such echoes should therefore be completely suppressed. In the *Salle Pleyel*, this is effected by treatment with a special sound-absorbing material applied to curved surfaces, the general arrangement of which is clear, without lengthy description, from Fig. 1. The floor, with its padded seats, is a very bad reflector, and in any event waves reflected from it will strike the back wall and be absorbed. The side walls, as can be seen from Fig. 3, are thrown back so as to make an acute angle at the stage end. This allows a larger capacity than if they were parallel, and also ensures, as can be seen, that no reflection from the side walls can, with respect to the direct sound, lead to an interval exceeding the allowable limit. There remain the stage wall and ceiling, which are treated as essential reflectors, in the following manner.

The stage wall, AB in Fig. 4, has its vertical profile in the form of a circle, inclined so as to throw the sound over the whole parterre, and is 7 metres high. The distance SA is about 10 metres, so that, with this height, the interval between direct and reflected wave does not exceed $\frac{1}{15}$ sec. If AB were much higher, this condition would not be satisfied. The horizontal profile is likewise approximately circular, as shown in Fig. 3. The first part of what may be called the ceiling is the reflector BC, designed to throw the sound into the first gallery. The vertical distance between B and C is likewise 7 metres, and the interval condition is satisfied, as it is by the third reflector CD which completes the covering of the hall, and throws the sound into the second gallery. The harmonious appearance of the curves is shown by Fig. 2, which is a view of the stage from the middle of the hall, behind the row of boxes. The excellence of the hearing, even from the back of the second gallery, has already been mentioned.

The Pleyel building contains, besides the two smaller halls, of excellent acoustics, many other features of interest to the physicist no less than to the musician. There are a large number of absolutely sound-proof studios, each of which is a room of light construction; the whole weight of this room rests on a layer of sound-proof material, spread on the floor of a slightly larger enclosing room which forms part of the main structure. No conductor of sound, such as a nail or screw, connects the interior room with the framework of the building. The interior room has its own separate windows, opposite those of the main building. Here again the effectiveness of the design is astonishing, the most muscular piano-playing in one studio being completely inaudible in the next.

M. Gustave Lyon's very simple principles have found, perhaps, their most striking exposition in

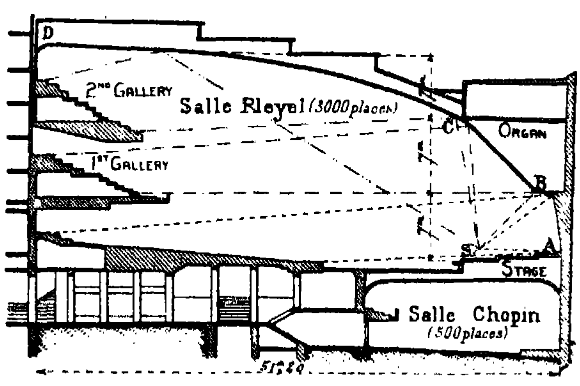


FIG. 4.—Vertical section of the hall.

the Great Hall, but he has behind him a series of remarkable achievements in the way of remedying, at small cost, the bad acoustics of certain halls, of which the best-known example is, perhaps, the hall of the Trocadéro at Paris, once notorious for its execrable sound properties, but now extremely satisfactory. His work is an excellent example of how far a little sound physics can be made to go in the hands of a man of bold originality and energy, who makes experiment and experience his guides.

E. N. DA C. ANDRADE.

Quantitative Estimates of Sensory Events

By Dr. ALLAN FERGUSON

An immense mass of literature has accumulated around the problem which was stated by Fechner more than eighty years ago as that of measuring the increase of a mental intensity in terms of the relative increase of the corresponding physical energy. His problem, in fact, was that of finding a quantitative measure of certain subjective sensations.

Other qualities apart, we can say of two sensation-brightnesses that they are *equal* in magnitude, that one is *greater* than the other, that one is *just perceptibly greater* than the other; the same may be said of two sensation-loudnesses. It is an unfortunate fact that such terms as loudness or brightness are used indiscriminately, sometimes in reference to the magnitude of the sensation, sometimes in reference to the magnitude of the stimulus which produces that sensation. It is desirable to adopt a uniform practice and, in what follows, these terms will be applied solely to the subjective sensations involved.

It seems, then, that just as in the region of physical stimuli we can use such terms as *greater*, *less*, and *equal*, so in the region of sensory events we can, and do, use the same terminology. Loudness and brightness are magnitudes, in the sense that colour and shape are not magnitudes. Are they quantitative magnitudes? Can we say by *how much* one loudness, or one brightness, is greater than another? This is a fundamental problem for psycho-physics, and it is essentially the question which Fechner essayed to answer.

Obviously the answer, logically treated, demands some knowledge of what we mean by measurement, and it is perhaps unfortunate for progress in psycho-physical work that the issue has, almost from the outset, been clouded by wranglings concerning the possibility of such measurements—arguments that have neither dealt adequately with the theory of measurement nor recognised the fact that quantitative physical magnitudes are not to be classed all under one head. Happily, the human mind is, in certain matters, reasonably illogical and, in the determination of purely physical magnitudes, physicists have been content to measure first and to theorise afterwards. Overmuch theorising concerning fundamentals is apt to have a paralysing effect: and it is well to be mindful of the fate of the centipede, who

> " . . . was happy quite,
> Until the frog, for fun,
> Asked her which leg went after which,
> Which raised her doubts to such pitch,
> She lay distracted in a ditch,
> Not knowing how to run ".

The psycho-physical measurements with which we are concerned have felt something of this paralysis; it is therefore a favourable augury for progress when we find Dr. R. A. Houstoun and Dr. L. F. Richardson, from different lines of approach, making quantitative measurements of sensation, without troubling overmuch to discuss their possibility.

It is perhaps simplest to approach the matter from the historical point of view. Gustav Theodor Fechner (1801–1887), physicist, poet, philosopher, and mystic, had unique qualities for the tasks which he faced—qualities, too, which were prone to raise suspicion in minds more prosaic than his own. This may account for some of the difficulties which his work encountered, as well as for the measure of success with which it met. It is essential, in order fully to appreciate those difficulties, to see Fechner against the background of his time and of his own philosophy, an animistic synthesis which should enable him " to follow consciousness itself into an underworld—a world which must then be no other than the abiding place of a general consciousness of which life is but a ripple on the surface ". Fechner, early in his endeavour to establish the relations which we have mentioned, chanced upon certain observations made by E. H. Weber about 1831. Weber had noted that, in a test on weight discrimination carried out according to certain specified rules, a skilled observer who could just discriminate between weights of 29 and 30 drams, could also just discriminate between weights of 29 and 30 ounces. Further, this relative sensitiveness remained the same over a fairly wide range. As it is usually stated, if, when the magnitude of the stimulus (*Reiss*) is R the just perceptible increase is δR, then, over a certain range,

$$\delta R/R = k.$$

The value of k in this particular instance is about 1/30.

With due precautions concerning experimental technique, and correct interpretation of the psychological conditions, the law holds for the sensory qualities associated with such diverse stimuli as sound, light, pressure, and even the stimulus to the sense of smell.

It must not be imagined that the law holds over more than a limited range. It obviously fails at the threshold of sensation and, if $\delta R/R$ be plotted as ordinate against R as abscissa, a curve results which is approximately horizontal over a very limited portion only—and it is to this portion that Weber's law applies.

Whether, however, $\delta R/R$ is constant, or is some complicated function of R, is a matter of little weight for the development of the rest of the argument. Let us, for the moment, confine ourselves to the region within which $\delta R/R$ is approximately constant. It is customary at this stage to point out (and the present writer confesses to what seems to be a lapse) that Weber's law, as thus stated, is quite unexceptionable, inasmuch as it is concerned exclusively with physical stimuli—weights which may be measured in dynes or in grams weight, sound intensities which may be measured in watts per square centimetre, and so on. This is, per-

haps, not quite correct, for, after all, δR is the *just perceptible* increase—the increase corresponding to an increase δS in sensation. What we have written as δR should therefore be written as a differential coefficient, and the statement of Weber's law should read

$$\delta R/\delta S = kR.$$

Stated in this form, the law may still be regarded as unexceptionable, though it is conceivable that some purist may criticise this form on the ground that it prejudges matters by assuming the existence of an *element* of sensation. However this may be, the next step, that of an integration of the equation just propounded, has been criticised on all hands. Integrated over the region for which Weber's law is valid, we find

$$S - S_0 = k \log (R/R_0),$$

where S_0 and R_0 refer to the values of S and R at an arbitrary origin within the prescribed region. Some curious algebraical exercises are to be found in the textbooks which give alternative methods of arriving at this relation, but it must be understood that *any* process by which one steps from the original statement of Weber's law to a statement of some functional relation between S and R involves an integration, implied or overt, and consequently involves the assumption that $\Sigma\delta S = S$.

And why not ? It would take too long here to discuss in detail the objections advanced, some of them apparently irrelevant, most of them variations on one theme.

Thus, William James remarks that when we consider sensations only, we are " quite unable to read any clear meaning into the notion that they are masses of units combined. To introspection, our feeling of pink is surely not a portion of our feeling of scarlet ; nor does the light of an electric arc seem to contain that of a tallow candle in itself. . . . Introspection shows, moreover, that in most sensations a new *kind* of feeling invariably accompanies our judgment of an increased impression ; and this is a fact which Fechner's formula disregards." Again, Stumpf says : " An sich ist und bleibt unlängbar, dass eine Empfindung nicht das Mehrfache einer anderen sein oder wenigstens nicht als solches erkannt werden kann. Mussten wir doch sonst die eine von der anderen subtrahiren, und die Rest für sich empfinden können. Jede Empfindung präsentirt sich uns als ein Unteilbares." This oft-quoted criticism has been regarded as final. None the less it possesses an inherent weakness which is best exposed by quoting Lewis Richardson's happily inspired parody—" One mountain cannot be twice as high as another. If it could, we ought to be able to subtract the one from the other and to climb up the remainder by itself. Every mountain presents itself as an indivisible lump."

Despite these criticisms, we do regularly make quantitative laboratory experiments in which, for example, it is found possible to arrange a series of grey shades from very light to very dark in what appear to be equal steps, and it is also an experimental fact that a comparison of these shades by photometric methods shows that their objective luminosities are in a geometrical progression ; this, and similar observations, if interpreted in the sense that they justify the Fechner equation

$$S - S_0 = k \log (R/R_0),$$

are apparently in direct contradiction to the criticisms just quoted. How can we escape the dilemma ? Historically, the escape was made by introducing the idea of sense intervals, a notion originally due to Delbœuf, and followed out by later writers. The idea is very clearly formulated by Titchener, who remarks, "the physical . . . magnitude is not a single term but rather a distance between terms. . . . We are apt to say, carelessly, that we have measured ' the highest point ' of Mt. Vesuvius, when we have in reality measured, in terms of our arbitrary unit, the distance between its lowest and highest points. It is not the point that is the magnitude but it is the distance between points. So with sensations ; we are apt to think of a brightness, or of a tone of given intensity, as a sensation magnitude, as itself measurable. Now the stimulus is measurable ; we can measure, in terms of some unit, the amplitude of vibration of the ether or air waves. . . . But the sensation, the brightness or the tone, is just a single point upon the sense scale—no more measurable in itself than the ' highest point ' on Mt. Vesuvius. The only thing that we can measure is the distance between two sensations or sense points."

This brings us to another criticism—that whenever we measure an ordinary physical quantity, we express it in terms of a unit of the same kind, of which it is a multiple or sub-multiple. Where is the unit of subjective brightness or loudness, ask the critics ? Well, we can arrange a series of steps of just noticeable differences, or we can, as we have seen, in the matter of shades of grey, arrange a series of steps of equal-seeming finite differences. It seems to satisfy most writers if these are taken as unit steps for the measurement of sense intervals, rather than as units for the measurement of sensation magnitudes. But it is again doubtful whether this attitude does more than evade the main point.

Most writers on the psychological side base their criticisms on some such fundamental assertion as that quoted earlier from Stumpf. This type of argument may be paralleled from many other parts of the literature. It has one inherent weakness—it does not discriminate clearly between two types of physical magnitude.

Such magnitudes as length, mass, and volume may be very readily conceived as being built up of units spatially juxtaposed in such a way that a unit length plus a unit length gives a length of two units, and so forth. But there are other physical magnitudes of which this is certainly not true, and yet on which quantitative measurements are regularly made. What, for example, is the result of adding, in the sense just used, a density of one to a density of one ? Or a unit temperature to a unit temperature ?

There is a host of such quantities—magnitudes such as surface tension, viscosity, density, diffusion

coefficient, and the like, which are not fundamental magnitudes of the type previously discussed, but may none the less be measured quantitatively. Whether the magnitudes concerned are fundamental or not, a mass, a temperature (not a hotness), a viscosity, even though they may be conceived artificially as built up by the multiplication of a certain unit quantity, do surely present themselves to introspection with the same singularity as does, say, a sensation-brightness.

Moreover (we are now in the region of physical stimuli), even though a physical magnitude X may present itself to introspection as a whole, if we find that X varies with temperature in such a way that $dX/d\theta = f(\theta)$, we have no hesitation in integrating to obtain a functional relation between X and θ, and are led thereby into no contradictions. So, while fully recognising that in one instance we are making deductions from introspection concerning a physical magnitude, and in the other instance from our judgment concerning a subjective sensation, we do not find ourselves led into any morass of contradiction if we regard a just noticeable difference or an equal-appearing interval as a unit of sensation, and artificially regard any sensation magnitude as so many times greater than that unit.

This is, apparently, what Dr. Houstoun does—and in doing so ingeniously avoids difficulties arising from departures from Weber's Law—when he plots $R \div (\delta R/\delta S)$ as ordinate against (log R) as abscissa. Since $d(\log R)$ is equal to $\delta R/R$, it follows that the area included between two ordinates separated by the small interval $d(\log R)$, the x-axis, and the element of the curve is equal to δS. Consequently, if $\Sigma \delta S = S$, the magnitude of the sensation corresponding to any stimulus R, is given by the area underneath the curve up to the ordinate at the point considered. This expresses an important advance. Incidentally, Dr. Houstoun finds that the curve obtained is very closely a Gaussian probability curve.

Other minor criticisms may be briefly noted. It has been remarked that the quantity $S - S_0$ does not represent a difference between two experiences, but an experience of difference. "The expression $S - S_0$ represents a single state of consciousness, the experience of a difference. It admits neither of dissection nor of mathematical treatment." Such a statement is merely dogmatic. Again, criticism of the choice of a just noticeable difference as a unit is contained in the remark that Fechner "regarded a sensation as the sum of a number of just appreciable unit increments of sensation. . . . He maintained that the change of sensation, obtained by adding one ounce to a weight of twenty-nine ounces was absolutely the same as that obtained by adding one dram to a weight of twenty-nine drams. *Of course, were this so, an ounce and a dram should produce an equal sensation.*" The italics are the present writer's. Comment is surely unnecessary.

Dr. L. F. Richardson has approached the matter from a different viewpoint. He endeavours to measure a sensation S "by directly estimating the *ratio* of unequal intervals both much larger than the least perceptible". Thus he has, from 316 observers, obtained estimates of the redness of certain pinks, these estimates being made by putting points on a line divided into 100 equal parts, white being zero, and red 100. The inquiry has been elaborated by mixing on a colour-wheel white and red in different proportions and estimating in the same way the redness of the resulting colour. If X is the position of the mark on the red scale and the angular amount of red (measured as a percentage of 360°) is θ, R. S. Maxwell finds that the results of 35 observers may be represented by $(\theta - 156)(X + 56) = -8736$.

One word concerning the *decibel*. This may, or may not, be used to define a unit of sensation-loudness. The physical measure of the intensity of a musical note of a given pitch rises, apparently, at a much more rapid rate than does the judgment of its sensation-loudness. If we measure physical intensities in, say, micro-watts per square centimetre, we obtain a series of numbers 1, 10, 100, 1000 . . . ., or 10^0, 10^1, 10^2, 10^3 . . . . As a matter of mere convenience it may be advisable to represent these intensities by the series 0, 1, 2, 3 . . . ., and we thus obtain a logarithmic scale of intensities of which the unit has been called the *bel*. One-tenth of this unit is the decibel, and it does happen that this unit corresponds fairly closely to the just noticeable difference of sensation-loudness between two notes of the same pitch at moderate intensities. But primarily the decibel represents a unit of intensity on a logarithmic scale, and need have no more to do with sensation measurements than has a scale of cents in the realm of music.

It is evident that, despite the amount of adverse criticism that has been brought to bear on Fechner's interpretation of Weber's Law, the matter is by no means closed, and that even the long-standing evasion of the difficulties in terms of sensation-intervals may stand in need of revision. The joint discussion between Sections A and J at the York meeting of the British Association should do much to clear up the major points at issue.

Obituary

Mr. H. G. Watkins

The tragic death on Aug. 20 of Henry George Watkins at the age of twenty-five years has removed the most promising and, indeed, the most prominent figure amongst British arctic explorers, a figure as yet too recent to be familiar to those outside a small circle.

The stages of Watkins' rapid advance to the forefront are simply told. At the age of nineteen, while still an undergraduate at Trinity College, Cambridge, he led a summer expedition to Edge Island in the Spitsbergen group. At the age of twenty he spent an arduous year in Labrador with one companion, J. M. Scott, the full story of which

has not yet been written. At the age of twenty-three he led the British Arctic Air-Route Expedition of 1930–31 in Greenland, a venture which is destined to be an important milestone along the road of polar history.

The full significance of the Greenland expedition has probably not yet penetrated the mind of the public, which was intrigued by and slightly critical of the dramatic events which surrounded the relief of Courtauld after his five months' sojourn alone on the ice cap. The narrative, now in the hands of a publisher, will correct some of the misapprehensions and will prove to the readers that here was a new type of expedition, following no former pattern: for Watkins ventured greatly without the lead of tradition; indeed, he constantly questioned the value of traditional methods and devised new and original ones of his own.

Led by Watkins, this group of young and inexperienced men set to work to disprove the wise saws of tradition, to dare great things and to carry them through. In a matter of weeks they were doing what was said to be safe only after years of experience—to drive dog-sledges, to hunt in the Eskimo method, to learn the kayak, to cross the ice-capped continent, to 'live on the land'.

In a crowded year those fourteen men accomplished enough journeys, by air, by sledge, by kayak and motor boat, to be a credit to half a dozen expeditions. A splendid set of men, it is true, but they will all admit that their results were due to the qualities of their leader and to the utter confidence they had in him. Of some of them the world will hear in due course, for they have been trained by the amazing young man whose loss we now deplore.

Of slight build, though strong and supple, somewhat shy and diffident in conversation, there was little in Watkins' appearance to mark him for what he was. Indeed, to the casual glance, his well-groomed figure, his neatly parted hair, his charming but hesitant manner, were signs merely of a pleasant young man who would always follow the precept of others and live quietly but efficiently in some ordinary walk of life. A conversation with him began to awaken doubts as to his being merely that. The alert poise of his head, the quick seizure of essentials, the calm statements of daring plans, all betokened a man of ideas and with the will to carry them out.

Even so, it was not until one saw Watkins in action that one realised his full qualities. It matters not what the action might be, wrestling with a friend, scaling a mountain-side, or, better still, as can be seen in the film of his expedition, 'rolling' a kayak. At one moment he is at ease, smiling and joking, like any other debonair young man; at the next he is tense and alert, head thrust forward, jaws set, and eyes shining with an expression almost grim, balancing his craft for a moment. He flings himself backwards and there is a flurry of paddle and arms, a swirl and a splash, and there he is again, relaxed and at ease, with a shy smile as though he were rather ashamed of his relapse into intense activity.

There must be added to this picture a shy dignity and a charm of manner, a modesty and a thoughtfulness which won all hearts. That is why Dr. H. R. Mill, in his appreciation in the *Times*, used the apt phrase, "so dear a scientific adventurer as 'Gino' Watkins"; that is why his companions would do anything for their leader, and why the news from Greenland has come as the shock of a bullet to his friends. F. D.

News and Views

Function of the British Association

IN suggesting as one reason for the continued success of the British Association the opportunity it affords, in an age of specialisation, for laymen to have intelligent contact with the seekings and findings of the scientific mind and for science to expound its own broad outlook, Sir Alfred Ewing, whose presidential address is printed in our Supplement this week, is on firm ground. The passing of the arrogance characteristic of an earlier age, the widespread belief that there are in science no longer any rigorous laws but only laws of probability, have made for a spirit which strengthens the sense of brotherhood between the scientific expert and the average man, who in his own way is also commonly a seeker after truth. The disappearance of dogma alone should assist the formation of an alliance which is overdue if we are to carry over into human affairs the methods of science and apply the dispassionate temper of science to the solution of our social, economic, and international difficulties.

Progress in Engineering Science

AFTER an engineer's review of the rapid progress in the study of the atom during the last few decades, including the discoveries of the neutron and the splitting of the lithium atom described this year, Sir Alfred Ewing referred to the important contribution of the Association to the advancement of engineering science. Early reports submitted to the Association demonstrated the conspicuous lack of science on the part of early British engineers, and the meagre contributions being made by them to the progress of hydraulics in contrast with the contributions of Italy, France, and Germany. The claim that the British Association by its reports and investigations, its discussions and committees, such as those leading to the establishment of the National Physical Laboratory and international standards for electrical units, has provided an invaluable scientific leaven, few would care to dispute. In his own recollections Sir Alfred Ewing covers the passing of many of the former fairy tales of science into the tissue of everyday life, and in the transition British engineering science has made as important scientific as practical contributions.

The Future of Science

A CONSPICUOUS feature in any such review is bound to be the realisation of the accelerated pace at which

development proceeds once the science has advanced well beyond its nursing stage. The pace of these developments is disturbing only because man is ethically unprepared for the bounty which engineering science has brought him. The world has been made practically instant in its interchange of thought, and international co-operation and brotherhood has become much more than a dream, were man fit for the tremendous moral responsibility which the new gifts and potentialities of life entail. Due to the slow evolution of morals, he has, however, not yet learnt to command himself, to relinquish old habits of thought, sovereignty, independence, which are inconsistent with the command of Nature now put into his hands. If the future is uncertain, at least those whose labours have brought such riches to man may be concerned but not despondent. They cannot but believe with Sir Alfred Ewing that the creative ingenuity which has brought these gifts will yet stir man to achieve in the future the better distribution of leisure and labour and the fruits of labour, which are essential to the continued enjoyment of his new powers. So we find the engineer man of science of the present century voicing the ideals of the great biologist of two or three decades ago.

John Locke, 1632-1704

THE tercentenary of the birth of John Locke occurred on Aug. 29 last, and to mark the event Messrs. J. and E. Bumpas, Ltd., have brought together at the Old Court House, Oxford Street, London, W.1, a well displayed and comprehensive series of engravings, manuscripts, and printed books, including the first edition of Locke's celebrated "Essay on the Human Understanding", as well as letters from Boyle, Newton, Sloane, and other men of his period. The collections are mostly in the ownership of the Earl of Lovelace, having happily suffered no disturbance or vicissitudes since their original assignment within the family. Various special loans that have been received greatly enhance the personal, artistic, and literary interest of the series. Thus, the impressive three-quarters length portrait of Locke, from Christ Church, Oxford, is there, whilst recently Lord Lee of Fareham has sent in an early plaster statuette of Locke, by an Italian hand. A letter from Locke, as a schoolboy, to his father, tells of seeing a "company of Quakers" in Westminster Hall, on business bent, whose leader's hat was "shook off"—recalling that Charles II. removed his own hat in the presence of Penn, explaining that it was the custom at Whitehall for only one person at a time to remain covered.

JOHN LOCKE was proposed for the fellowship of the Royal Society, by Sir Paul Neile, on Nov. 19, 1668, and at a meeting in the following week he was elected and signed the charter book. In that year, too, the illustrious Marcello Malpighi was elected. On St. Andrew's Day, Nov. 30, 1672, Locke was chosen a member of council, and Pepys and Evelyn were brought in at the same time. Earlier in the year, at an ordinary meeting held at Arundel House, Hooke had mentioned his interest in Otto von Guericke's experiments. There was one which he thought deserved to be tried before the Society, namely, that of a sulphur ball, when revolved and rubbed, having a considerable attractive power, and representing the properties of the earth. Mr. Locke, so we learn, intimated that himself had made some experiments with such a ball, and promised that he would bring it to the Society at the next meeting. At that meeting, however (Hooke being present), when he was called upon, Locke excused himself; he had forgotten it, and promised it for the next. Thereafter nothing happened, and, as a matter of fact, Locke's interests in the philosopher's doings were eclipsed by other pregnant interests. He seems, though, to have maintained constant intercourse with Boyle, who signs as "Yr. very affectionate friend", saying he looks up to Locke as a virtuoso.

Report on the Post Office

THE Report of the Committee appointed "to inquire and report as to whether any changes in the constitution, status or system of organisation of the Post Office would be in the public interest" has now been published (Cmd. 4149. London: H.M. Stationery Office, 9*d*. net). The Committee, which consisted of Lord Bridgeman (chairman), Lord Plender, and Sir John Cadman, is of opinion that the total transference of all Post Office communication services to a public utility company or statutory corporation is impracticable, and is neither necessary nor desirable. The Committee considers that the main modification in the status of the Post Office which is required is in respect of its relationship to the Exchequer, and it is recommended that the contribution of the Post Office to the Exchequer should be fixed, for the next three years, at £11,500,000 plus 50 per cent of any cash surpluses in excess of that figure, the residue to be available for the improvement and development of Post Office facilities and services.

As regards organisation, the Committee recommends that the control of Post Office business should be effected through the medium of a functional board presided over by the Postmaster-General. In addition to the Assistant Postmaster-General, the board would comprise four or five members of the Post Office staff, such functions as general operating and supply, engineering and research, finance, and personnel being represented upon the board. A senior permanent member of the board would act as vice-chairman and would be styled 'Director-General', with the duty of ensuring that board decisions were made effective and that continuity and unity of policy were maintained. A decentralisation of administration is recommended under regional directors who would exercise jurisdiction over all the services. Stress is laid on the necessity for fluidity of interchange of staff between headquarters and the provinces. The Committee believes that under these proposals the engineer will be able to play a larger and more effective part in the determination and execution of policy, and it is considered that there should be no bar to a technical officer holding an administrative post, provided he has shown himself to possess administrative ability. Con-

tact with the public will be secured by means of an Advisory Council acting in a consultative capacity, and it will be consulted by the Postmaster-General on questions of general policy. The Report is obviously a document of first importance, and we hope to discuss the Committee's recommendations in due course.

Progress and the Scientific Worker

WITH the great changes inherent in modern civilisation, a new outlook has become essential. Science, the handmaiden of progress, cannot be divorced from industry, administration, social problems, etc.; and with this point of view in mind, the new series of *Progress*, which is being published as *Progress and the Scientific Worker*, aims at giving voice to the new citizenship. Necessarily, therefore, within its covers will be found the joint expressions of the scientific and humanistic outlook. This is made possible since it is the official journal of the Association of Scientific Workers and the British Institute of Social Service. *Progress*, the first bi-monthly number of which is for July-August 1932, has made a splendid beginning. Sir John Russell contributes an informative article on "The Coming Generation". He gives an interesting résumé of recent advances in the agricultural sciences. For example, in the harvesting of an acre of wheat, hand work of olden days involved 32 man hours, the early machine 19 man hours, and the modern machine 4 man hours. But the reduction of these man hours by mechanisation has its drawbacks. On one farm in Norfolk, for example, until recently, 40 men were employed, and now, since its 'mechanisation', only 4 are employed. One of the greatest problems of to-day, which will inevitably be handed on to the coming generation, is the employment of such displaced men.

CLOSELY allied to the problems discussed in this article is the paradox of plenty, which is the subject of an article by Mr. Percy Alden. There is a surplus throughout the world of wheat, cotton, tea, coffee, rubber, oil, and tin. Poverty-stricken countries are no doubt desirous of buying, but the purchasing power is absent. Now, there are, according to Mr. Alden, two essentials to recovery from this world-wide depression: international agreement over debts, reparations, and armaments, and an attempt to settle the currency question which is crippling industry in many countries. The inevitable connexion of industrial development with creative science forms the basis of Sir Richard Gregory's suggestive and illuminating article entitled "Science and the Nation". Sir Richard gives many convincing examples of the 'triple alliance' of creative science, purposeful invention, and skilled labour, and the resulting conditions, which have proved of national and international importance. "Science not only creates new means of existence and new sources of employment by the discovery of new principles and substances, but also places extended use of power at the disposal of every one. . . . Modern technical achievement and scientific thought foreshadow a new economic structure for society in which they should be used to exercise decisive influence upon the major politics of the State as well as upon their administration." Through such activities unbounded possibilities are presented to the new generation, including the problem of the displaced manpower discussed by Sir John Russell. Besides other articles of general interest, the new journal contains scientific, social, industrial, and educational news, reviews, and notes. The price is 6*d*. per copy, and the annual subscription 5*s*.

Mohenjo-daro Dating

A FURTHER stage towards precision in the dating of the prehistoric civilisation of the Indus valley is marked by Mr. Ernest Mackay's letter to the *Times* of Aug. 27. Mr. Mackay records the discovery at Mohenjo-daro of a fragment of a steatite vase which bears exactly the same intricate and very unusual pattern as a double vase of the second period of Susa. It was found at a depth of 28 ft. below datum, very little above water-level in the soil when the river is at its lowest. The inference that it was an import from Elam is borne out by the material of the fragment, a greenish-grey steatite identical with that of the Susa II. double vase. A conservative estimate for the dating of Susa II. would place the Mohenjo-daro find at about 2800 B.C. On the other hand, Mr. Mackay points out that the seal, of undoubted Indian workmanship, found by Dr. H. Frankfort at Tell Asmar, is inscribed with animals which occur commonly on seals and sealings at Mohenjo-daro (although as yet only two cylinder seals have been found) and can be contemporaneous only with the upper levels of that site, occurring at some three to seven feet below datum. This, on the basis of Dr. Frankfort's dating of the Tell Asmar seal, would give a dating of 2500 B.C. for the upper levels at Mohenjo-daro—a reduction on the previous provisional dating. It would thus appear that between the lower levels, 28 ft. below datum, and the upper levels, contemporary with the period of the Tell Asmar find, some three hundred years elapse—a conclusion to which Mr. Mackay states that he already inclined on other grounds.

Protection of Antiquities in France

A QUESTION of much interest to archæologists in general, though naturally of more immediate moment to French archæologists, is raised by Dr. R. Vaufrey in the current issue of *L'Anthropologie* (t. 42, Nos. 3-4), in describing certain steps which have been taken by the Prehistoric Section of the Commission des Monuments historiques for the more efficient administration of the law relating to the protection of prehistoric antiquities. It would appear that French archæologists are feeling some alarm lest they should be on the eve of a condition of affairs prophesied by M. Marcellin Boule more than forty years ago, when he foresaw that, unless effective measures were taken, France's priceless store of prehistoric antiquities in the Dordogne would be exhausted. In the opinion of prominent French archæologists, that time is indeed close at hand. Every effort is to be made to avert it. Present financial conditions preclude anything in the nature of the creation of a department for the purpose, but steps are being taken to secure a stricter enforcement of the existing law. The Prehistoric Section of

the Commission, which is the body responsible, wishes to place no check on scientific excavation, whether by organisations or individuals properly accredited; but it aims at the 'amateur' who seeks to exploit a site for his personal and pecuniary gain. In this praiseworthy object, French archæologists will have the moral support of their colleagues, whatever their nationality, and also in what is clearly their secondary object, namely, to secure the control of the finds—thus averting such a catastrophe as occurred when the skeletal remains found in the caves of Le Moustier and Combe Capelle were lost to France.

Restoration of Roman Bridge, Littleborough, Lancs

ADVANTAGE has been taken of the unemployment problem at Littleborough, Lancs, to invite the co-operation of voluntary workers among the unemployed on the 'dole' in the repair of the Roman road over Blackstone Edge. A part of the work contemplated has now been completed by the repair of the Roman bridge at the junction of Black Castle Clough and Rag Sapling Clough, which carries the road over Black Castle Clough. Some time ago, Mr. J. H. Price of Rochdale directed the attention of the Rochdale Literary and Scientific Society, and through it, of the Society for the Protection of Ancient Monuments, to the fact that the bridge was in danger of being swept away. Mr. Price's examination of the bridge had revealed the fact, which had been completely forgotten in the course of time, that originally it consisted of two culverts, one of which had collapsed and had become completely overgrown with grass. The original length of 25 ft. had thereby been reduced to 12 ft. This culvert has now been restored and the bridge repaired, under Mr. Price's supervision, with the assistance of local firms who volunteered transport, material, etc. The work was carried out with the approval of H.M. Office of Works. Both Roman road and bridge are scheduled as ancient monuments. It is hoped to carry out repairs on part of the road in due course by the same method.

Salamanders and the Pollution of Drinking Water

A CURIOUS and unsuspected source of pollution of drinking-water has just been discovered in Cattaraugus County in western New York State (William G. Hassler in *Natural History*, New York, May-June, 1932, p. 303). Certain spring supplies of water continued to give unsatisfactory laboratory tests even after drastic steps had been taken to protect the springs from outside pollution. Further examination revealed that salamanders, large newt-like amphibians, belonging to four different species, occasionally occurred in the springs, and though a first examination showed that only a small percentage contained the colon bacillus, the investigation was continued. Nearly two hundred purple salamanders (*Gyrinophilus porphyriticus*) were marked with identification discs, and subsequent collecting proved that sometimes individuals wandered as much as sixty-five feet from the stream, apparently in search of food. One was observed eating fly larvæ which were living on mammalian refuse, and this settled the question of how colon bacilli entered the food canals of the salamanders. A second surprise was sprung upon the investigators when they studied more closely the numbers of salamanders in the springs themselves. Purple salamanders were not thought to be particularly common, but repeated nightly visits resulted in a catch of 144 in one spring, which contained about fifty more uncaught. Yet there were occasions when not one of these salamanders could be found, although all the catch was marked and returned to its spring. Laboratory experiments gave some idea of the extent to which contamination might take place. Over a period of 122 days, one salamander excreted a sufficient number of colon bacilli to contaminate 237 gallons of water heavily enough to be considered dangerous on every test. It is believed that the creatures act as reservoirs or incubators, and once infected with colon bacilli, continue to excrete them so long as there is food in the stomach or intestines to supply nourishment to the bacteria.

Fishing with Captive Sucking Fish

MORE than four centuries ago, Columbus observed the strange custom of catching fish and turtles by means of captive sucking fish in the "Jardinellas de la Reina". The general impression has been that these islands were near Haiti and Jamaica, but C. Ralph de Sola points out that a more likely place is the archipelago in the Bight of Manzanillo on the south coast of Cuba (*Copeia*, p. 45, 1932). If this be so, Gudger is wrong in concluding that the original site of the discovery of Columbus "no longer witnesses the exploits of the fisherman fish", for the Siboneyes of southern Cuba, a people of Carib extraction, still practice remora-fishing to a considerable extent. De Sola describes a fishing trip from Matanzas, Cuba. To the under-planks of the boat two sucking-fishes were firmly attached by their discs, and when a turtle was sighted basking on the surface, the fishes were detached and cast as far as possible towards the turtle. The sucking-fishes were themselves held captive by a long thin rope of *majuga* bark, attached in front of the tail, and so soon as they had fixed upon their quarry, the lines were drawn in and the captured hawk's-bill turtle taken aboard. Throughout the proceedings the lines had to be kept taut, and the author states that owing to the arrangement of the lamellæ of the sucker, it is impossible for the remora to relax its hold when tension is placed on its horizontal axis. It is curious that so peculiar a mode of fishing should be found in many distant parts of the world, but Gudger's records from various localities in Africa, Asia, Australia, South America, and the West Indies show that it is almost cosmopolitan in tropical seas.

Eradication of Slugsand Snails

IN a communication to NATURE on the eradication of slugs, which was the subject of a note in these columns on July 16 (p. 90), Mr. Walker Van Riper, 771 South High Street, Denver, Colorado, contributes another method of control based on his own experience. A generous distribution of a solution of ammonium sulphide (1 part in 30 parts of water) killed nearly all the slugs present in his garden in a single

(*Continued on p. 361.*)

Supplement to NATURE

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An Engineer's Outlook

By Sir ALFRED EWING, K.C.B., F.R.S., President of the British Association

PRESIDENTIAL ADDRESS DELIVERED AT YORK ON AUG. 31, 1932

AGAIN, for the fifth time, the British Association meets in York, a city of proved hospitality and the stage of great events. York is a monument of history; its very stones are eloquent of the past. Not the least of the episodes it has witnessed was the birth of this Association. We hold York in filial honour and affection. We are nomads who have strayed to the ends of the earth: we have been as far-flung as the British flag. We have enjoyed the welcome of many strange hearths. But here there is nothing unfamiliar. We take delight in coming home to a birthplace of happy memory and in recalling hopes which the past hundred years have generously fulfilled.

Last year the infant of 1831 celebrated its centenary in the vigour of manhood, with a plenitude of pomp and circumstance which demanded no less ample a setting than the metropolis of the Empire. For president we had a man of world-wide fame, who fittingly embodied the imperial aspect that is part of the glory of the British Association. We had long known General Smuts as soldier and statesman: to some it may have come as a surprise when they found him also a philosopher, a student of ideas no less than a maker of history and a leader of men. It would be an impertinence for any successor in this chair to praise General Smuts; to follow him is perforce to follow far behind. But one may congratulate the executive on the happy instinct which recognised that the occasion was unique, and so led them to an unusual—not to say a daring—choice. It was amply justified by the event. Now they have returned to the beaten track along which presidents for the most part plod, and have made a selection for which I am glad to have no responsibility.

Of General Smuts I would say one word more. His occupancy of the chair not only added to the lustre of our rejoicings: I like to think it also had a deeper significance. May we not regard it as a harbinger of the spirit of goodwill and sanity which civilisation longs for, but does not yet see? Our hundred years of science have done sadly little towards curing the nations of mutual mistrust. Surely it was a good omen that, in marking the close of one century of achievement and the opening of another, we should have had for president a citizen of the world whose life has been a lesson in subordinating the lower patriotism to the higher good, who by example no less than by precept has taught his fellows that they should beat their swords into ploughshares and not learn war any more.

Now we revisit our birthplace well aware of our maturity. We have scored our first century and begun to compile our second with the easy assurance of a Bradman or a Hobbs. At once the question arises, Is that assurance justified by the Association's continued vitality? Do we still give the community reason to support us? Or are we a survival, trading on a reputation which our present activities do little to increase? I put the question bluntly—nowadays we are all familiar with disagreeable stock-takings and shrinking values—but it need not detain us long. I am confident you will find no trace of decrepitude. It is true that the sciences included in our purview have become specialised and differentiated to a degree that would make ridiculous any claim to the qualified omniscience which was possible in our

early days. It is also true that each department of science now has its own society of votaries who meet, as it were, in a masonic temple and converse in a jargon that has little if any meaning for the general ear. But these very facts make this Association the more useful. Notwithstanding the restrictions of specialism, science has its own broad outlook, demanding expression and explanation to laymen; and more than ever is it true—far truer than it was a hundred years ago, when we were ridiculed as a hodge-podge of philosophers and made the target of an unsympathetic Press—that laymen want to have intelligent contact with the seekings and findings of the scientific mind.

I say seekings and findings rather than conclusions, for that word has too final a ring. Here we may note a striking change in the temper of the investigator. I am old enough to remember a time when some of the spokesmen of science (never, indeed, the greatest) displayed a cocksureness that was curiously out of keeping with the spirit of to-day. Among contemporary leaders nothing is more general than the frank admission that they are groping in a half-light, tentatively grasping what at best are only half-truths. Things that to one generation seemed to be essential parts of a permanent structure are treated by the next as mere scaffolding. The quest of truth goes on endlessly, ardently, fruitfully. Yet with every gain of knowledge we realise more clearly that we can never really know. To understand, as Einstein lately said, is to draw one incomprehensible out of another incomprehensible. From time to time we discover a fresh relation between observed phenomena, but each of the things which are found to be related continues to evade our full comprehension; and that is apparently the only kind of discovery we can achieve. Our joy in the quest itself never fails; we are constantly learning that it is better to travel than to arrive.

The philosophical implications of this altered attitude are many—indeed they concern the deepest springs of thought. What I wish at the moment to point out is that the new spirit strengthens a sense of brotherhood between the scientific adept and the average man, who in his own way is also commonly a seeker after truth. He listens gladly when the specialist drops his toga and admits that in scientific matters the only dogma is that there is no dogma. Obviously, too, the advance of science makes an increasing claim upon the layman's notice through its technical applications. It invades his home and alters his ways; it affects almost every feature of the daily round; it brings him interests, comforts, wealth; it enormously enlarges his powers of work and play. Further, at a time like the present, when we carry a load of social, political, and economic discontents, the ordinary citizen doubtless reflects that if only we could apply the dispassionate temper of science to the difficulties of the hour, we might face them with less waste of effort and greater likelihood of settlement.

These are a few of the reasons why the British Association keeps its hold on the public. It links experts with one another and with laymen, to the benefit of all. Experts gain by indulging in a short interval of comparatively lucid self-expression. They gain also by trying to understand each other, which is by no means so easy as one might suppose. To meet under these happy conditions is a stimulus to everybody. An old worker in science looks gratefully back on his attendances at the British Association, not only as delightful human events but also as red-letter days in his own development, as milestones in the unceasing march of his subject, and as helps in the hard task of keeping himself more or less in step.

It is recorded that York was chosen for our birthplace because in the Yorkshire Philosophical Society the infant would secure intelligent dry-nursing at the hands of a large body of friendly amateurs. In a letter to the secretary of that Society, Sir David Brewster described the purpose of the proposed Association in the following words:

> "The principal objects would be to make the cultivators of science acquainted with each other, to stimulate one another to new exertions, to bring the objects of science more before the public eye, and to take measures for advancing its interests and accelerating its progress."

There, in a nutshell, is what the Association set out to do, what it may fairly claim to have done, and what it still does. If you want an illustration, you had it last year when a great audience sat for hours, with every sign of sustained attention, while the evolution of the universe was discussed by British and foreign specialists of acknowledged authority, immense learning, and conspicuous variety of opinion.

At the end of that symposium the debate was admirably summed up by Sir Oliver Lodge, the Nestor of physics, who in every sense has filled a big place in our gatherings for more than fifty years. He has taught us much: would that he could teach his secret of perpetual youth! In a recent volume of reminiscences he tells delightfully of the meetings he has frequented and the friendships to which

they have led. If he is thankful for them, so are we for him. Not a few of us have found inspiration in the fountain of his knowledge, in the spontaneity and aptness of his spoken word, in the width of his sympathy and understanding, and have learnt to love him for his large humanity.

My own first contact with these meetings antedates even that of Sir Oliver. Sixty-five years ago it chanced that the Association in its peripatetic course came, for the first time, to my native town, and I was taken, a boy of twelve, by my mother to the Section of Mechanical Science, having already announced my intention of becoming an engineer. To the pundits of Section G, we must have seemed an odd pair, the douce minister's wife and the shy little boy in his kilt. It was by my own wish, of course, that I was taken, and my mother counted no labour lost that might develop intelligence in her family of sons. The boy could not understand much of what he heard ; it was something, however, to see the leonine head of the sectional president, Macquorn Rankine, over whose engineering textbooks he was later to spend many assiduous hours. There is no boundary to a mother's dreams, but in their wildest excursion they can scarcely then have pictured what is happening in this hall to-night.

Here let me make a confession which may also serve as an apology. I have the unwelcome distinction of being the oldest president the Association has ever suffered. In its primitive years the average age of presidents scarcely exceeded fifty : one of them, aged only twenty-nine, afterwards founded the Cavendish Laboratory, and so did a service to science which it would be impossible to overvalue. As time went on, the choice fell on older men, and now the electors have taken what one hopes may be regarded as an extreme step. But, as it happens, this is not the first time I have read the president's address. At the Edinburgh meeting of 1921, the president, Sir Edward Thorpe, was prostrated by illness and asked me to act as his mouthpiece. The small service so rendered brought an unexpected reward. Some newspaper report must have confused the platform substitute with the real president, for a well-known novelist sent me a copy of one of her romances, which was no doubt meant as a tribute to Sir Edward. It was called "The Mighty Atom"—an arresting title. Perhaps that is why I did not read beyond the title-page. Without close examination, it was put by a more orderly hand than mine on a shelf that already held works on like subjects by authors such as J. J. Thomson and Rutherford and Bohr. "The Mighty Atom" was said to be one of the best sellers of its day: in that respect, if in no other, it found congenial company when it was joined on the same shelf by a series of volumes from the fascinating pens of Eddington and Jeans. These, however, I need not tell you, I have read and re-read, to my entire pleasure and partial understanding.

Atomic Physics

If "The Mighty Atom" was an arresting phrase, it was also an apt one. For we now know the atom to be indeed mighty in senses that were little suspected by the begetters of atomic theory. It has been mighty in sweeping away ideas that were found inadequate, in demanding fresh concepts, in presenting a new world for conjecture and experiment and inference, in fusing chemistry and physics into a single science. It is found to be mighty in the complexity of its structure and the variety of radiations it may give out when excited to activity. It has unravelled for us the bewildering tangle of spectroscopic lines ; and, most surprising of all, the atom, however seemingly inert, is mighty in being a magazine of energy which, for the most part, it locks safely away. This is fortunate, for if the secret were discovered of letting loose the atomic store, we should invite dissolution at the hands of any fool or knave. It is also fortunate that in the furnace of the sun, at temperatures far higher than those of our hottest terrestrial infernos, the stored energy of the atom is drawn upon, as we believe, and has been drawn upon for ages, to keep up that blessed radiation which makes man's life possible and is the source of all his power.

In the middle 'nineties there set in an astonishing renaissance of physical science, which has centred in the study of the atom and extends by inevitable logic to the stars. In quick succession came three great discoveries : the X-rays by Röntgen in 1895, radioactivity by Becquerel in 1896, and the electron by J. J. Thomson in 1897. Sensational, puzzling, upsetting, these events inspired every physicist to new activities of thought and equipped every laboratory with no less novel methods of research. A flood of further discovery followed, the flow of which continues unabated. Within the last few months notable items have been announced that well deserve our attention. It may not be inappropriate if I try for a few minutes to touch—however lightly—on one or two aspects of this subject, as it is seen through the eyes of an engineer.

Thanks mainly to J. J. Thomson, Rutherford, and Bohr, we now recognise the atom of any substance

to be a highly complex structure, built up, so to speak, of two sorts of blocks or brickbats—the electrons, which are indivisible units of negative electricity, and the protons, which are indivisible units of positive electricity. It is strangely simple to be taken back, as it were, to the nursery floor and the childish game, and given just two sorts of blocks, exactly alike in each sort, and exactly the same number of each sort, with which to build the universe of material things. The blocks are unbreakable: we cannot produce them or destroy them or change them. In respect of electrical quality the two kinds are equal and opposite, but they contribute very unequally to the atom's mass, each proton (for some reason not yet understood) contributing about 1840 times more than each electron. Every substance is made up of blocks of the same two sorts. If you compare different substances you find that the diversity of their chemical and other properties arises solely from differences in the number and arrangement of the blocks which compose their atoms. Any atom, in its normal or electrically neutral state, must contain an equal number of protons and electrons.

All the protons in any atom are gathered close together at the centre, along with some of the electrons, forming a compact, dense portion which is called the nucleus. Although the nucleus accounts for nearly the whole of the atom's mass, it occupies no more than a very minute fraction of the atom's volume. Those of the electrons which are within the nucleus doubtless serve to bind the protons together; the other electrons constitute, as it were, a voluminous crinoline, or rather a series of crinolines, extending relatively far away from the centre and giving the whole atom an exceedingly open structure. Within that open structure upheavals may be caused by outside agents in various ways. One or more of the electrons in the crinoline may be temporarily removed (as, for example, by the action of heat or by the incidence of energetic radiation), and the atom is then said to be ionised: for a time the balance between positive and negative is upset. But the missing electron returns to its place, or another comes instead, and when this happens a definite amount of radiation is given out, much as energy is given out when a weight falls from one to another landing of a staircase. We may speak of the landings as energy levels. The radiation which issues when an electron falls from one energy level to another constitutes what is called a photon.* It has two aspects, behaving in one like a particle and in the other like a group of waves, and at present we have to accept both though we cannot fully reconcile them. The photon carries a definite quantity of energy and is characterised by a definite frequency of vibration. Its energy depends on the two levels between which the electron falls, and this determines the frequency of the vibration which the photon conveys, for the frequency is equal to the energy divided by that mysterious constant of Nature, the quantum of action discovered by Planck. In any element all the atoms have the same set of energy levels; these contribute to the emission spectrum and account for its groups of spectral lines. In heavy atoms there are many energy levels, and consequently very many lines appear in their spectra.

* We owe the name 'photon' to Prof. G. N. Lewis, of Berkeley, California, who proposed it in a letter published in NATURE of Dec. 18, 1926.

What we have to realise is that all matter consists of the two kinds of electricity, protons and electrons, held apart we do not know how. To the early experimentalists who electrified rods of resin or glass by rubbing them, electricity seemed no more than a curious attribute of matter; now we regard it as matter's very essence—the ultimate stuff out of which every atom is built. If you ask, What is electricity? there is no answer, save that it is a thing which exists in units of two sorts, positive and negative, with a strong attraction for each other, and that in any atom you find them somehow held apart against that attraction, with a consequent storing of potential energy. They are prevented from coalescing, although the difference of potential between them is nearly a thousand million volts. Why they do not flash together is a mystery—one of the many mysteries which physicists have still to solve.

Engineers are accustomed to the idea of storing energy in a condenser by charging the opposed plates to a potential of a few scores or hundreds or thousands of volts. That is done by transferring some of the crinoline electrons from one to the other plate: it involves only a minute supplementary separation, which disappears when the condenser is discharged. In every atom we have a permanent separation of electricities; the protons and electrons look at one another, so to speak, across an immensely greater dielectric gulf which no laboratory operation ever causes them to bridge. That is why every atom is a magazine of energy, the quantity of which (mc^2) is proportional to the atom's mass.

Any of the usual operations of the electrical engineer, such as charging and discharging a condenser or a storage battery, or driving a dynamo

and conducting electricity from it to a distant station where it can actuate a motor or heat the filaments of lamps to incandescence, may be described as the setting up and the breaking down of a comparatively small extra difference of potential between the opposed electricities in some of the atoms of the engineering plant. In every process of industrial electricity, on whatever scale, what happens is a temporary enlargement of the potential difference which always exists between electrons and protons, and then a return to what may be called Nature's *status quo*. But those supplementary differences of potential which the engineer first superimposes and then allows to disappear are exceedingly small, even at their greatest, in comparison with the gigantic difference which the normal condition of the atom itself involves.

A notable event of the year is the strong evidence which Dr. J. Chadwick, of the Cavendish Laboratory, has found for the existence of what is called the neutron—a type of particle in which an electron and a proton are associated in particularly close juxtaposition. There is a like close association between electrons and protons in the nucleus of any heavy element, but it had not previously been discovered in a single isolated pair. Twelve years ago Lord Rutherford conjectured the existence of such a particle, and described the properties it should possess. Its excessive smallness and density, together with its lack of an external electric field, give it a unique power of penetrating matter. It is too slim to be confined under pressure in any vessel: it will simply slip through the walls. The normal hydrogen atom has the same two constituents, one proton and one electron, but in nothing like the same intimacy of association, for the hydrogen atom wears its electron as a bulky crinoline which confers on it an immensely greater volume. The neutron, on the other hand, may be said to have taken the crinoline off, folded it up, and put it in its pocket. Not to be too fanciful, we may at least describe the partners as clasping one another so tightly that the electron has ceased to be a fender; none the less, as a unit of negative electricity it still serves to give electrical balance to the pair. Though so close together, the two constituents of the neutron remain separate and distinct, parted by nearly as many million volts as in a hydrogen atom. In this hitherto unknown particle, the existence of which the experiments of Dr. Chadwick seem definitely to have proved, we have a new physical entity of extraordinary interest and a powerful tool for further research.

Lord Rutherford was the first to discover and name the nucleus. It is the inner sanctuary of the atom, the repository of secrets many of which have yet to be disclosed, almost unapproachable, not only because of its smallness but also because of the electric field in which it is encased. Recognising the nucleus to be a richly charged strong-room, Rutherford has spared no effort to break it open. He has submitted it to a furious bombardment, using as missiles the α-particles which radioactive substances project. These particles, each consisting of four protons and two electrons compactly built together, have the necessary velocity and energy to penetrate to the atom's heart. Rutherford had perforce to fire into the 'brown': he could not aim his gun, nor even tell when it would go off: the chances of a hit were no more than one in many millions. But hits were in fact obtained—hits so effective that they chipped off protons and caused the missiles to be absorbed, thus realising the dream of the alchemist by making one element change into another. That was a dozen or more years ago: since then his attack has lost none of its severity. It has been taken up under his guidance by a school of workers, and many further secrets of the nucleus have been revealed.

Quite recently two of his disciples have gone one better, as disciples sometimes do, to the joy of their lords. Dr. J. D. Cockcroft and Dr. E. T. S. Walton have used missiles of their own making instead of those that come spontaneously and intermittently from substances such as radium or thorium. By beautiful devices they have applied their knowledge of electrical engineering and their mastery of electrical technique to project single protons into the nucleus of lithium, using a steady potential of several hundred thousand volts to give the projectile sufficient penetrating power. An atom of lithium has (usually) seven protons and four electrons in its nucleus; the other three electrons constitute the crinoline. Here again it was a case of firing into the 'brown': out of millions of shots a few reached their billet. When the projected proton forces an entry into the lithium nucleus it creates a domestic disturbance of the liveliest kind. For with the seven protons already in occupation it makes an eighth; the group then splits into two sets of four, each taking two of the electrons, and they fly violently apart with an energy drawn from the atomic magazine. The result is that two helium atoms are formed. This is a notable achievement, the first artificial splitting of the atom by a laboratory process in which there is no recourse to the violent projectiles which radio-

active substances provide. It has been followed up by successfully applying the same method to break up the atoms of other elements.

It is a satisfaction to learn that in all the encounters and emissions and absorptions that are studied among atoms and photons and the parts of atoms there is, so far as we yet know, strict compliance with the accepted principles of conservation in respect of momentum and energy and mass, though matter (in the ordinary sense) is liable to transformation into energy and energy into matter. When radiation is emitted some matter disappears, for the atom that emits it loses a little of its mass; when radiation is absorbed, a like quantity of matter comes into being.

But the engineer finds himself obliged to admit that no mechanical model of the atom can be expected to give an adequate picture of that strange new world. Our mechanical ideas are derived from the study of gross matter, which is made up of vast aggregates of atoms, and any model must share the limitations this implies. It is futile to explain the constitution of the atom in terms applicable to gross matter, just as it would be futile to study the psychology of an individual by observing only the movements of crowds. So we must expect to find within the atom and among its parts qualities and actions different in kind from those we know, and paradoxes which, without a wider vision, we cannot interpret. Such a paradox indeed confronts us at the present time, when we try to harmonise the wave aspect and the particle aspect of the photon, of the electron, and indeed of matter itself. These things are still a mystery—a riddle which some day we may learn to read. Meanwhile we do well to remember that any attempt to portray the structure of the atom in the language of ordinary experience is to give undue significance to symbols and analogies that are more or less invalid. Qualifying phrases like 'so to speak' or 'as it were' cannot be escaped. They are confessions that the image is inevitably a distortion of the reality it is intended to suggest.

Advancement of Science by the British Association

Let us now glance back to the early days of the Association, and trace a little—a very little—of what it has done for the advancement of science, both pure and applied. The two inevitably march together. Between discovery and invention there is, in effect if not always in form, a close partnership with a constant interchange of advantage. No discovery, however abstract, is safe from being turned to practical account; on the other hand, few, if any, applications fail to react in stimulating discovery and providing the experimentalist with more effective weapons of attack.

From the first the Association took cognisance of engineering as one of the subjects it was created to advance. One of its earliest acts, and a very wise one, was to invite reports on the state of science: these were called for in many different fields and were written by the best available experts. In the first batch of such reports were two that dealt with engineering, one on the strength of materials and the other on hydraulics. As it happened, they were of very unequal merit; but they are alike in this, that they demonstrate how conspicuous was the lack of science on the part of early British engineers.

The engineers of those days were big professional figures. They had covered the country with a network of roads and bridges and canals; they had drained the fens; they had built harbours and lighthouses. By multiplying factories, by extending the uses of coal and iron, they were laying the foundations of that commercial supremacy which, so long as it lasted, we took for granted as a sort of national right. They had taught the world how to light towns by gas, and were beginning to drive ships by steam. Above all, they had shown that a new era of locomotion was about to set in. A railway connecting Liverpool with Manchester had been opened: its success was proved, and schemes were projected that would soon utilise labour on a large scale for a host of tunnels and cuttings and embankments, and so relieve the scourge of unemployment which—as we also know—follows the scourge of war. The engineering pioneers were sagacious men who put their faith in experience; they knew little of theory and cared less. Instinct and personality carried them through difficulties of a kind that science might have helped them to solve or to avoid. They had the sense to profit by their own mistakes.

It is significant that in 1832, when the British Association called for a report on the present state of our knowledge of hydraulics as a branch of engineering, the terms of reference included this curious phrase: "Stating whether it appears from the writings of Dutch, Italian, and other authors that any general principles are established on this subject".

The report was written by George Rennie, a son of the greater Rennie who left us a monument of his genius—I wish I could say an imperishable monument—in Waterloo Bridge. After giving a

good summary of the work of foreign theorists the reporter remarks:

"It only remains for us to notice the scanty contributions of our own countrymen. While France and Germany were rapidly advancing upon the traces of Italy, England remained an inactive spectator of their progress."

It is clear that there was much need for the scientific leaven which the new Association could, and did, provide.

Another of the early concerns of the Association was with the performance of steam-engines. At the date of our foundation, more than fifty years had passed since the inventions of Watt provided an engine fit to serve as a general means of producing power. Its earliest application, and still at that date its most common one, was in the pumping of mines. Engineers took a professional and even sporting interest in what they called its 'duty', meaning the amount of water pumped through a given height for each bushel of coal consumed. Nevertheless it is a remarkable fact that neither they nor the physicists of that period had any notion that the process involved a conversion of heat into mechanical work.

It is difficult for us now to imagine a world of physics and engineering where the idea had not yet dawned that there was such a thing as energy, capable of Protean transformations, but in all of them conserving its total amount. Enlightenment was soon to come, and our meeting-rooms furnished the scene. In 1843 Joule brought before one of the sections his first determination of the mechanical equivalent of heat. He spoke with the modesty natural—in those days—to a man of twenty-four. His paper was received in chilly silence. Two years later, after further experiments, he reappeared; but again no notice was taken of the heresies of a youthful amateur. Nothing daunted, he prepared a fuller case for the Oxford meeting of 1847, perhaps remembering that Oxford is the home of lost causes. In a narrative written many years later, Joule has told how the chairman suggested that, as the business of the Section pressed, he should not read the paper, but merely give a brief account of his experiments:

"This [he says] I endeavoured to do, and discussion not being invited, the communication would have passed without comment if a young man had not risen in the Section and by his intelligent observations created a lively interest in the new theory. The young man was William Thomson."

But Thomson, though deeply interested, was not at first convinced. Nearly four years more were to pass before he satisfied himself that the doctrines of Joule did not clash with the teachings of Carnot, of which he was then an enthusiastic proselyte. At length he became a convert; he saw, as we should now say, that the First Law of Thermodynamics was in fact consistent with the Second. Then indeed he accepted the principles of Joule in their entirety and was eager in their support. Quickly he proceeded to apply them to every part of the physical domain. Along with Clausius and Rankine, he formulated the principles which govern the whole art of producing power by the agency of heat. The steam turbine of Parsons, the gas-engines of Otto and Dugald Clerk, the oil-engines of Daimler and Diesel, with all their social consequences in making swift travel easy by road and possible by air, are among the practical results. On the same thermodynamic foundation was built the converse art of mechanically producing cold, which we employ in ever-increasing measure for the import and storage of our food. Joint experiments undertaken by Joule and Thomson led to a further discovery, which later enabled the process of refrigeration to be carried very near to the limit of coldness which Thomson himself established as the absolute zero. In the hands of Linde and Claude the Joule-Thomson effect as a means of producing extreme cold has created new industries through the liquefaction of air and the separation of its constituents by methods of fractional distillation. However cold, however near the absolute zero, was the Association's first reception of Joule, we may claim that in effecting a conjunction between him and Thomson it made amends. Their meeting in 1847 ushered in a new era both of scientific theory and of engineering practice.

Of the Association's many other services there is little time to speak. When the telegraph developed in the middle of last century and spread itself across the Atlantic, largely under the guidance of that same William Thomson (whom later we knew as Lord Kelvin), there were no accepted units in which electrical quantities could be measured and specified. The scientific world was as badly off then for a standard of electricity as the commercial world is now for a standard of value. The need of electrical standards was urgently felt, by none more than Thomson himself. He stirred the Association to act: a strong committee was set up, and in time its work served as a basis of international agreement. There is no danger that any country will wish to 'go off' the standards thus established. To settle them was an incalculable boon to science no less than to technics. It paved

the way for the revolution of the eighteen-eighties, when electricity passed, almost suddenly, from being no more than the servant of the telegraph to be master of a great domain. It was then that the electric light and the electric transmission of power gave it a vastly extended application, and the fundamental discoveries of Faraday, the centenary of which we lately celebrated, came into the kingdom for which they had waited nearly fifty years.

Another notable achievement of the Association was to promote the establishment of a National Physical Laboratory. Informal talks at our meetings in the 'nineties led to the appointment of a committee which moved the Government of the day to take action. The Laboratory was constituted, and Sir Richard Glazebrook was appointed its first head. What it has become in his hands and the hands of his successor, Sir Joseph Petavel, does not need to be told. From small beginnings it has grown to be an influential factor in the world's scientific progress, and a legitimate subject of national pride.

Another by-product of quite a different sort is the memorial to Charles Darwin which we hold as trustee of the nation and of all nations. At our meeting in 1927 the president, Sir Arthur Keith, spoke in his address of the house where Darwin lived and worked, pointing out how admirably it would serve as a monument of the great naturalist. No sooner was the suggestion published than a donor came forward, whose devotion to the memory of Darwin expressed itself in a noble gift. Sir Buckston Browne not only bought and endowed Down House, but also arranged with pious care that the house and its grounds should exhibit, so far as was possible, the exact environment of Darwin's life. The pilgrims who now visit this shrine in their thousands see Darwin's study as it was when the master thought and wrote, and can reconstruct the habit of his days. There could not be a more appropriate memorial. Its custody by the Association involves obligations which are by no means small, and we may claim that they are worthily fulfilled.

One may safely say that there is no department of scientific endeavour our meetings have not aided, no important step in the procession of discovery they have not chronicled. It was at our meeting of 1856 that Bessemer first announced his process of making a new material—what we now call mild steel—by blowing air through melted pig iron. Produced in that way, or by the later method of the regenerative furnace and the open hearth, it soon revolutionised the construction of railways, bridges, boilers, ships, and machinery of all sorts, and it now supplies the architect with skeletons which he clothes with brick and stone and concrete. It was at the Oxford meeting of 1894 that Lodge demonstrated a primitive form of wireless telegraph based on the experiments of Hertz, a precursor of the devices that were brought into use a little later through the practical skill and indefatigable enterprise of Marconi.

At the same meeting there was an epoch-making announcement by the late Lord Rayleigh. His patient weighings of the residual gas which was found after depriving air of all its oxygen led him to the discovery of argon. That was a surprise of the first magnitude; it was the herald, one may say, of the new physics. Next year his colleague, Ramsay, presented other members of the family of inert gases. It is curious to recall the indifference and scepticism with which these really great discoveries were received. Some of the chemists of that day seem to have had no use for inert gases. But the stones which the builders were at first disposed to refuse are become head stones of the corner. In the architecture of the elements they fill places that are distinctive and all-important; they mark the systematic sequences of the periodic law. In a metaphor appropriate to atomic physics we may describe them as coy ladies with a particular symmetry in their crinoline of electrons, unresponsive to advances which other atoms are ready to make or to receive. Inert though they be, they have found industrial uses. Helium fills airships; argon fills incandescent lamps; and neon, so modest a constituent of the atmosphere that you might think it born to blush unseen, has lately taken to blushing deliberately and even ostentatiously in the shop-signs of every city street. In the field of pure science it was neon, outside the radioactive elements, that first introduced us to isotopes; and helium has a greater glory as the key to radioactive transformations and historian of the rocks. Disciples of evolution should be grateful to helium for delivering them from the cramping limits of geological time which an earlier physics had mistakenly imposed.

My own recollection covers many surprises that are become commonplaces to-day: the dynamo, the electric motor, the transformer, the rectifier, the storage battery, the incandescent lamp, the phonograph, the telephone, the internal combustion engine, aircraft, the steam turbine, the special steels and alloys which metallurgists invent for every particular need, wireless telegraphy, the thermionic valve as receiver, as amplifier, as

generator of electric waves. To that last we owe the miracle of broadcasting. Who, a generation ago, would have imagined that a few yards of stretched wire outside the window and a magic box upon the sill could conjure from adjacent space the strains of Beethoven or Bach, the exhortations of many platforms, the pessimism natural to those who forecast the weather, and the optimism of orators who have newly dined ?

"Sounds and sweet airs, that give delight and hurt not.
Sometimes a thousand twangling instruments . . .
And sometime voices . . . that, when I waked,
I cried to dream again."

I know no product of engineering more efficient than that magic box. It needs no attention ; it is always ready for service ; and when you tire of it you have only to switch it off. A blessing on it for that ! Heard melodies may be sweet, but those unheard are often sweeter. Do you ever reflect, when you pick and choose among the multitude of airs and voices, or shut out all from your solitude of thought, that they are still there, physically present, individual, distinct, crowding yet not interfering, besetting you though you do not perceive them, silent until you determine that one or another shall catch your ear ? Go where you will, to the ocean or the wilderness or the pole, you cannot escape that vast company of attendants ; they come to you, unheard, unseen, from every quarter of the globe with a swiftness no other messengers approach. Is any fairy tale so strange as that reality ? In all the wizardry of science surely there is nothing more wonderful than this.

Discovery and the Future of Mankind

Among the inventions which have revolutionised the habits of modern man some were developed by steps that were mainly empirical. Others, especially those that are most recent, have had a very different history : science has been their incubator and their forcing-house. In the advance of any invention there is bound to be an element of trial and error, but when the scientific method is consistently applied the proportion of error is small and progress is swift. We see this exemplified in the development of mechanical flight, where one difficulty after another has been vanquished by aid of well-directed theory and well-related experiment. Or consider that immensely important modern art, the art of communication by telegraph and telephone, by wire and 'wireless'. There the efforts of scientific engineers were dominant at every stage, and it was through their guidance that the art quickly achieved its world-wide triumphs. It is true that in the story of long-distance radiotelegraphy there was a striking episode where the courage of the practical inventor forestalled the discovery of a recondite scientific fact. It happens that the wireless waves from a radio-station, instead of shooting out straight into space as such rays might be expected to do, become bent in the upper regions of the atmosphere, taking a surprising and convenient curvature which enables them to travel round the surface of the globe. An unlooked for kindness on the part of Nature has provided what we now call the Heaviside layer by which she works this happy trick. The strange fact that the rays could somehow bend was recognised and applied by Marconi before anybody had a rational explanation to suggest. Speaking broadly, however, it was scientific nursing of the infant art, and scientific culture throughout its period of growth, that brought it to the splendid manhood which now blesses mankind.

I think we may regard the whole art of electrical communication as an unqualified blessing, which even the folly of nations cannot pervert : in that regard it differs conspicuously from some other inventions. Before it came into use the sections of civilised man were far more separate than they will ever be again. There could be scant sympathy or understanding, little chance of effective co-operation among communities scattered over the earth. A calamity might fall on one and be already old before others knew of it to offer help. Now we have all the world made practically instant in its interchange of thought. Through this physical linkage, which annihilates both space and time, there is opened a possibility of quick discussion, common resolution, simultaneous action. Can you imagine any practical gift of science more indispensable as a step towards establishing the sense of international brotherhood which we now consciously lack and wistfully desire ? Should that aspiration ever become more than a dream we shall indeed have cause to bless the creators of electrical communication, to praise them and magnify them for ever.

In the present-day thinkers' attitude towards what is called mechanical progress we are conscious of a changed spirit. Admiration is tempered by criticism ; complacency has given way to doubt ; doubt is passing into alarm. There is a sense of perplexity and frustration, as in one who has gone a long way and finds he has taken the wrong turning. To go back is impossible : how shall he proceed ? Where will he find himself if he follows this

path or that? An old exponent of applied mechanics may be forgiven if he expresses something of the disillusion with which, now standing aside, he watches the sweeping pageant of discovery and invention in which he used to take unbounded delight. It is impossible not to ask, Whither does this tremendous procession tend? What, after all, is its goal? What its probable influence upon the future of the human race?

The pageant itself is a modern affair. A century ago it had barely taken form and had acquired none of the momentum which rather awes us to-day. The Industrial Revolution, as everybody knows, was of British origin; for a time our island remained the factory of the world. But soon, as was inevitable, the change of habit spread, and now every country, even China, is become more or less mechanised. The cornucopia of the engineer has been shaken over all the earth, scattering everywhere an endowment of previously unpossessed and unimagined capacities and powers. Beyond question many of these gifts are benefits to man, making life fuller, wider, healthier, richer in comforts and interests and in such happiness as material things can promote. But we are acutely aware that the engineer's gifts have been and may be grievously abused. In some there is potential tragedy as well as present burden. Man was ethically unprepared for so great a bounty. In the slow evolution of morals he is still unfit for the tremendous responsibility it entails. The command of Nature has been put into his hands before he knows how to command himself.

I need not dwell on consequent dangers which now press themselves insistently on our attention. We are learning that in the affairs of nations, as of individuals, there must, for the sake of amity, be some sacrifice of freedom. Accepted predilections as to national sovereignty have to be abandoned if the world is to keep the peace and allow civilisation to survive. Geologists tell us that in the story of evolution they can trace the records of extinct species which perished through the very amplitude and efficiency of their personal apparatus for attack and defence. This carries a lesson for consideration at Geneva. But there is another aspect of the mechanisation of life which is perhaps less familiar, on which I venture, in conclusion, a very few words.

More and more does mechanical production take the place of human effort, not only in manufactures but also in all our tasks, even the primitive task of tilling the ground. So man finds this, that while he is enriched with a multitude of possessions and possibilities beyond his dreams, he is in great measure deprived of one inestimable blessing, the necessity of toil. We invent the machinery of mass-production, and for the sake of cheapening the unit we develop output on a gigantic scale. Almost automatically the machine delivers a stream of articles in the creation of which the workman has had little part. He has lost the joy of craftsmanship, the old satisfaction in something accomplished through the conscientious exercise of care and skill. In many cases unemployment is thrust upon him, an unemployment that is more saddening than any drudgery. And the world finds itself glutted with competitive commodities, produced in a quantity too great to be absorbed, though every nation strives to secure at least a home market by erecting tariff walls.

Let me quote in this connexion two passages from a single issue of the *Times* (June 25, 1932). In different ways they illustrate the tyranny of the machine. One is this:

> "The new Ford works built upon a corner of Essex . . . will soon be able to produce motor-cars at the rate of two a minute."

The other comes from Moscow. It also relates to the mass-production of motor-cars, and indicates how Russia is reaching out towards a similar perfection under the austere stimulus of the Five Years' Plan:

> "The Commissar lays down dates for the delivery of specified quantities by each factory and invests twenty-one special directors with extraordinary powers to increase production, threatening each director with personal punishment if deliveries are belated."

We must admit that there is a sinister side even to the peaceful activities of those who, in good faith and with the best intentions, make it their business to adapt the resources of Nature to the use and convenience of man.

Where shall we look for a remedy? I cannot tell. Some may envisage a distant Utopia in which there will be perfect adjustment of labour and the fruits of labour, a fair spreading of employment and of wages and of all the commodities that machines produce. Even so, the question will remain, How is man to spend the leisure he has won by handing over nearly all his burden to an untiring mechanical slave? Dare he hope for such spiritual betterment as will qualify him to use it well? God grant he may strive for that and attain it. It is only by seeking he will find. I cannot think that man is destined to atrophy and cease through cultivating what, after all, is one of his most God-like faculties, the creative ingenuity of the engineer.

Summaries of Addresses of Presidents of Sections*

Physics in the Search for Minerals

PROF. A. O. RANKINE, in his presidential address to Section A (Mathematical and Physical Sciences), entitled "Some Aspects of Applied Geophysics", reviews the development of geophysical prospecting, a practical application of physics which, although originating abroad, has during recent years attracted some attention in Great Britain. The subject is a border-line one between physics and geology, and the complications usually displayed by the underground structures sought demand the combined efforts of physicists and geologists, if reliable results are to be obtained.

It is necessary to distinguish between methods based on definite physical principles and those commonly called 'divining'. Without necessarily condemning the latter, they must be excluded from discussion, since the *modus operandi* is unknown. A geophysical method, properly so-called, must have as its basis the differentiation of some recognised physical property as between rocks, such as density, elasticity, magnetic susceptibility, or electrical conductivity. It involves measuring on or near the earth's surface, by means of suitable apparatus, the physical effects associated, either naturally or through artificial stimulation, with such variations of physical properties.

In dealing first with the gravitational method, a special tribute is due to the work of Baron von Eötvös, the pioneer of geophysical prospecting. The Eötvös torsion balance, designed in the first instance for purely geodetic work, is an instrument of amazing performance. While rendering it robust enough for field work, Eötvös managed to preserve a sensitivity sufficient to allow measurement of gravitational non-uniformities so small as those arising from the rotation of the earth on its axis. The use of such an effective device in investigating density differences of underground formations seems now to be obvious, but it was not until comparatively recently that Eötvös, under the persuasion of the geologist, Prof. de Böckh, agreed, somewhat reluctantly, to turn his attention to problems of economic importance. As a result, the gravitational method of prospecting has since been used very widely. Its principal achievements have been the location and delineation of salt domes with which oil is associated.

The seismic method, although not yet based on so sure a foundation as the gravitational method, has been practised widely on account of its greater celerity, and under conditions which exclude effective use of the torsion balance. As regards the magnetic method, with the portable magnetometers at present available, the method is practically limited to the detection of rocks rich in ferromagnetic material. If the sensitivity of magnetometers could be improved to a degree comparable with that of the Eötvös balance, the scope would be greatly extended; work, therefore, on these lines seems to be desirable.

After a short reference to electrical methods, Prof. Rankine concludes with an appeal for the continuation and extension in Great Britain of research work in the various branches of this comparatively new and difficult subject.

Stereochemistry of Living Matter

In his presidential address to Section B (Chemistry) Dr. W. H. Mills considers "Some Aspects of Stereochemistry". Referring to the electron theory of valency, he explained how, by assigning a stereochemical interpretation to the valency octet, a rule can be obtained which gives an approximate indication of the relative directions of the valencies in compounds to which the octet theory applies. He showed that the 'tetrahedral octet' provides a simple interpretation of the Walden inversion in certain classes of reactions, and that it enables an explanation to be given of the readiness with which *trans*-elimination is effected. He showed also that in the Beckmann transformation, *trans*-migration of the groups is inherently more probable than *cis*-migration.

Dr. Mills devotes the latter part of his address to the problem of the optical activity of living matter. He points out the bearing on this question of the stereospecificity of reactions between molecularly dissymmetric compounds: an optically active substance reacts with unequal velocities with the *d*- and *l*-forms of a dissymmetric compound. Since vegetable organisms can convert their inorganic food-stuffs into optically active compounds, the reactions involved in vital processes must be highly stereospecific. In living matter we find every dissymmetric component present in one configuration only, and these configurations are so correlated that each component encounters that antimer only of its co-reactants with which it interacts the more rapidly. It is evident that living matter thus constituted must be more efficient than

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a hypothetical tissue in which every dissymmetric component is present in its racemic form.

If we imagine a form of living matter composed of inactive materials, it would consist—by reason of the stereospecificity of vital reactions—of two more or less independent systems working side by side. One of these systems—'the *d*-system'—would include those forms of dissymmetric vital products found in Nature, such as *d*-glucose and *l*-leucine. Working alongside this there would be the enantiomorphous *l*-system. In the growth of vegetable tissue composed of such inactive living matter the *d*-system would be producing the components of the new tissue of the configurations found in Nature, and the *l*-system would be producing their enantiomorphs at an equal rate, and the new tissue would be optically inactive. In a tissue in which one of these systems is in excess, their rates of increase will be unequal. The relative proportions of the components of the two systems in the new tissue will be determined by the complicated laws which connect their rates of production with the concentrations of their generators in the old tissue.

The components of the new tissue will be built up from the food-materials by chains of synthetical reactions, and the rates of formation of the end-products will be controlled by the velocity of the slowest links in the chains. If we imagine a case in which the slowest link is a bimolecular reaction proceeding at a rate proportional to the concentrations of the two reactants, and suppose that the old tissue contained *twice* as much of the *d*- as of the *l*-system, there would be *four times* as much of the *d*- as of the *l*-product in the new growth. We cannot suppose that the relations are so simple as this, but so long as the velocities of the bi- and polymolecular reactions concerned in growth increase with concentration more rapidly than according to the first power (and it seems likely that they will), any excess of one system over the other in the old tissue will become greater in the new growth. An optically inactive growing tissue will then be, in respect of its optical inactivity, in unstable equilibrium. If there is the slightest departure in either direction from exact equality of the *d*- and *l*-components of the tissue, this inequality will increase with growth continuously according to a compound interest law, until eventually the system originally in defect will be completely swamped by the enantiomorphous system.

Given a slight initial bias, an association of complex organic substances which has the property of increasing itself indefinitely at the expense of inorganic substances must necessarily become optically active. If the initial quantity of the association be sufficiently small, the existence of the bias can be accounted for by the laws of probability.

Human Industries and the Ice Age

In the first part of his presidential address to Section C (Geology), entitled "The Contacts of Geology: The Ice Age and Early Man in Britain", Prof. P. G. H. Boswell discusses the training of geologists, and comments on the handicap under which present-day students of geology commence their university careers.

The second and longer part of the address deals with the ice age and early man in Britain. A review of the evidence of successive glaciations and of the intervening episodes makes it clear that a provisional correlation with early human industries can now be attempted satisfactorily. The sequence of these industries, as also of the deposits with which they are associated, is most complete in East Anglia, and the deposits of this area may therefore be appropriately selected as the standard for Britain. This standard succession may be summarised thus: Pre-Chellian and possibly Early Chellian industries, followed by the First Glaciation (Scandinavian Drift, Norwich Brickearth, etc.); First Interglacial interval, lengthy but cold, with extensive valley erosion, human industries doubtful; Second Glaciation (Great Chalky Boulder Clay); Second Interglacial interval, warm, lake-like deposits of Hoxne, Ipswich, etc., valley aggradation and terrace formation, re-arrival of *Corbicula fluminalis*, human industries ranging from Acheulian and Clactonian to Early Mousterian (Levalloisian); Third Glaciation (Upper Chalky Drift, Trail and Coombe Rock); Third Interglacial interval, uplift and valley erosion, Middle to Late Mousterian, and Early to Middle Aurignacian; Fourth Glaciation (Hunstanton Brown Boulder clay), probably Magdalenian.

This succession may be followed through Lincolnshire to Yorkshire and Durham, where the four glacial episodes are indicated by the Basement Till of the coast, the Lower Purple Boulder Clay, the Upper Purple Boulder Clay, and the coastal Hessle Boulder Clay. The Kelsey gravels, containing *Corbicula fluminalis*, appear to lie between the Lower and Upper Purple Boulder Clays. The upper part of the succession is traceable also into Northumberland. As a result of the work of the Geological Survey and of Raistrick and other investigators, the glacial deposits of the Lake District and the southern Scottish ice advances can be

linked up with those of the country east of the Pennines. The advance of the Lake District and Scottish ice into the Irish Sea region and Cheshire plain enables correlation to be made with the Aurignacian deposits sealed in the caves of North Wales, and also with the sequence of events, described by Wills, which accompanied the diversion of the Severn drainage by way of the Ironbridge Gorge. Thus is established a link with the terraces of the lower Severn and its tributaries. The work of Dr. Mabel Tomlinson shows the connexion, via the Moreton Gap, between the deposits of the Avon-Stour system and those of the upper Thames, investigated by Sandford. Correlation can also be effected, though not without difficulty, between the physical and climatic episodes and human industries of the upper Thames and of the lower Thames, concerning which Dewey and Dines have provided useful data.

In general, the relationships of the various human industries to successive glaciations in Britain, as interpreted by reference to a standard succession, show much more agreement than might have been expected.

THE BASIC NATURE OF SYSTEMATICS

The Right Hon. Lord Rothschild has devoted the greater part of his life to the study of species, and, realising that " knowledge begins with the observation of phenomena, not with experiment ", he uses many of these observations and those of other systematists to emphasise the importance of systematics, in his presidential address to Section D (Zoology), entitled " The Pioneer Work of the Systematist ".

The animal world, which appears almost infinite in the number of different forms, presents a picture of life confusing in its endless variety. Yet there is orderliness underlying this seeming confusion, and it is the task of the systematist to discover it and sort out the multitude of organisms accordingly. At the time of Linnæus this was comparatively easy (his " Systema Naturæ " contains fewer than 4300 species); but to-day the task is much more difficult, for not only are many more species already known and being discovered, but a much deeper knowledge of morphology and bionomics is also required. Besides this, the systematists' views have profoundly changed. At the time of Linnæus, marked individual differences were diagnostic of a species, and a species was considered constant. To-day, however, a great range of variability in organisms is known to exist. So profound is this phenomenon that the present-day systematist does not look upon similarity as necessarily meaning relationship, neither does dissimilarity necessarily mean specific distinctness. Variability is an essential character of everything alive; instead of species being constant, they are flexible. For example, the number of specimens of the commonest British mouse-flea (*Ctenophthalmus agyrtes*) required in order to have one pair exactly alike would be several million billions, certainly in excess of the whole flea population of Great Britain. This is tantamount to stating that no two fleas are alike.

The systematist is a direct necessity to defensive and applied biology. Applied biology can only be a science if based on sound systematics. This is evinced in all branches of botany and zoology, especially in their applied aspects, such as entomology and parasitology. The help which the systematist can extend to biology, however, is for him only a side-issue; he is a student of pure science, the driving force in his study of systematics being the irresistible attraction which the subject has for him.

Description, identification, and classification of new species are not the ultimate aim of the systematist; they are merely preliminary. A natural classification is based on blood-relationship, and thus an inquiry into evolution is entailed. Hence systematics involve not only the static study of form but also the dynamic study of development and evolution. A species, in other words, must be read critically and in its entirety—its ontogeny and phylogeny as well as its structure.

The study of certain diagnostic features has resulted in the dividing up of species into geographical races or subspecies. This involves a tremendous amount of new considerations. For example, the individual characters of the ancestral specimen do not influence the formation of a new race; only that which is inheritable and non-pathological is of importance. Then, where two geographical races meet, there may be a strict line of demarcation with no attendant complications, or, on the other hand, there may be interbreeding producing an impure population of subspecies, not strictly distinguishable from, or identical with, either parent subspecies. This phenomenon is another which calls for further investigation.

Other geographical races which the systematist considers identical, though possessing no morphological differences, may have acquired physiological differences, which only experiment can detect. Another possible distinction may be found amongst gregarious mammals which show inheritable likenesses, probably impressed upon the herd by the dominant bull.

Systematics are not concerned solely with species and their variations but also genera and the higher categories, grouped according to relationship, that is, descent.

A brief survey, such as this, of the study of systematics is sufficient to illustrate its complicated nature and the possible ramifications into other branches of pure and applied biology; it demands the best scientific brains—those who not merely float but also dive.

World Reactions to Industrial Revolution

Various types of society, the world over, are trying to graft on to their ancient and traditionalist schemes of life the new scheme of mass-production developed as a dangerous experiment first in England about a hundred and fifty years ago. This reaction to the modern industrial revolution forms the substance of Prof. H. J. Fleure's presidential address to Section E (Geography) entitled "The Geographical Study of Society and World Problems". In vastly increased numbers the peoples of the world, some more, some less touched by the idea of mass-production, are jostling one another as never before, and various types of society have become, willy-nilly, standing dangers to others. In nearly all cases, societies have been in the past nearly self-contained groups, external commerce having been subordinate to internal exchange; and many of the modern groups that gather round a unity of language are attracted to this idea of self-sufficiency, often from fear of economic or political subjection. But diversity of past experience leads them along diverse lines of development, for human societies are primarily associations between men and the earth in particular areas; and must be studied objectively as such, as well as in relation to what they receive from without.

The groups of men who live by hunting, with collecting as an adjunct, were long ago the leaders of the world's life, and the lords of regions that can be determined by finds of their implements as apparently including North and East Africa and South-western Asia, with parts of Europe at times. They are now pressed into far corners in South-western Africa, Australia, and so on, or into the very unfavourable areas of the equatorial forests of the Old World. They have felt the pressure of agricultural peoples spreading from the Euphrates, the Fertile Crescent and Egypt, especially since cultivators and herdsmen have combined in social groups, with the latter as, usually, the ruling element, more markedly so after the horse had become the ally of the ruler.

The spread of the idea of cultivation and herding into inter-tropical Africa met many hindrances from climate, physiography, difficulty of adaptation of crops, fly-belts, phosphorus- and salt-deficiencies, that together kept back social development. Agriculture remained dependent on the hoe as a woman's implement, with the village poor and sometimes only temporary, and no development of cities; with medicine men rather than a more or less learned priesthood; message sticks and the like in place of a written script; and other contrasts all telling against the African, who must be thought of as struggling with special environmental difficulties. But agriculture even in Eurasia long remained traditionalist, though cities, priesthoods, writing, media of exchange, and so on enlarged men's vision; and, in conformity with tradition, this agriculture was usually on a communal basis.

So long as society remained traditionalist, there was implicit in its life the notion of the land as a trust handed along the generations, and that idea has struggled towards larger expression among the peoples who still look to agriculture as their main activity. Among such peoples, notably the French, the notion of stability is thus very strong, and the huge increase of industrial populations, on an essentially unstable foundation, in England, Germany, the United States and Japan, is naturally very disturbing. France has taken up into her strong system a certain measure of industrialist activity. China and India find the corresponding effort far more dangerous to their traditionalist schemes. Africa is waking up to the new contacts and ideas. In fact, the problems of the modern world can be expressed in terms of the multifarious reactions of peoples of diverse experience to the industrial revolution and its schemes of mass-production. But, underlying the diversities of reaction, there is everywhere a growing germ of the idea of economic independence that somehow has to be assimilated by a world policy.

Britain's Access to Overseas Markets

Prof. R. B. Forrester, in his presidential address to Section F (Economic Science and Statistics), directs attention to the increased anxiety over the position of the British export trade. The trade of the world has increased, but Britain's share has diminished. The reasons advanced to explain the slowing down of overseas sales of recent years have

fallen into two main groups. First come those which emphasise the natural course of world industrial development, bringing with it the growth of local industries in many countries; these new efforts, stimulated by the opportunities of the war years, have competed with the British staple exports such as textiles, iron and steel, engineering, and fuel output. Along with these difficulties, there has been the long series of casual misfortunes to which international trade has been subject in the years since 1920, such as restrictive customs tariff policies and the financial, exchange, and currency troubles.

The second group suggests that there is some special retarding cause operating against British export sales which is not present in the case of other countries exporting to world markets. This, it is argued, is to be found in the rigidity of the British income and price structure, which has not proved so adjustable as that of her trade rivals to the falling price levels of international trade.

It is, of course, possible to hold that all these causes are operating, and that Britain may be passing into a phase where the home market is of growing importance and overseas sales of diminishing extent. In the face of these difficulties, it is of some interest to inquire what the evidence is regarding Britain's access to external markets. The evidence of the economic missions which have examined selected markets in which British trade is losing its position suggests that, while price has been the main factor in explaining the decline, the selling methods require close examination and revision; adequate, no doubt, at a time of British predominance, they seem in need of alteration and adjustment to meet new forms of competition. It is also doubtful if the structure of the overseas distributive organisation is adequate to carry the increased tasks which must be undertaken to push British trade, and certain suggestions are made to meet this difficulty.

The position with regard to tariffs is considered only to see how far Britain is at any disadvantage compared with her trade competitors in gaining access to overseas markets. The central feature of her policy within recent times has been the unconditional interpretation of the 'most favoured nation' clause; this has in general guaranteed to her, entry of her goods exported at the lowest available rates of duty in the tariffs of other countries. It seems doubtful, however, how far this is now an adequate method of dealing with the world tariff situation, and to gain favourable access to external markets Britain may have to join tariff groups and employ group treaties to secure her position. One of her chief difficulties is that, like Germany, her exports are to so great an extent finished goods.

Britain is working her way to a new equilibrium between home and external markets and to a new proportion in the relative importance of her overseas markets; she could certainly strengthen her position in overseas areas by improving her means of access in selling method and distributive organisation, as well as in directing her policy towards the creation of low tariff groups.

The Call to the Engineer

The engineer and scientific worker have shown the way to plenty. All the material necessities and comforts of life, with our known methods of manufacture and transportation, could be produced and distributed in sufficient quantity to make the inhabitants of the world ten times more wealthy than they are on the average to-day. That is the claim made by Prof. Miles Walker in his presidential address to Section G (Engineering), entitled "The Call to the Engineer to Manage the World".

Civilisation has been extending for centuries, and the application of steam power to manufacture has been in operation for one hundred years, yet by far the greater portion of the inhabitants of Europe and America are very poorly supplied with the things that make life full, free, and enjoyable. If we go outside the modern States to the teeming millions of China and India, we find that only a little has been done to improve the lot of the peasant, who still lives by bodily toil, and receives no share of that fullness of life which we know to be possible when the machine lightens our labour and education opens the mind.

The great difference between what is possible and what has been achieved is in a great measure due to the incompetence of the rulers. The men who get into positions to control towns, provinces, and States the world over are very seldom men of real ability. They are talkers rather than doers. They have not undergone any test to show whether they can arrive at a logical conclusion from a given set of premises. Though there are brilliant exceptions, as a class they have neither the education nor the mentality for their job.

Contrasting the way in which things are managed in a great engineering undertaking with the way in which things are muddled in the world at large, we are led to believe that if the engineers (in which term, for brevity, may be included all scientific men) took a greater part in world management, they would make a greater success of it. In this

world crisis there is a call to the engineer to manage the world.

One of the main things wrong with the world is that there is no proper plan to enable the people to make use of what science has made available. Men's efforts are mainly directed at buying and selling at a profit instead of being directed to the making of things they want, and distributing them in the least expensive way.

Two improvements that the application of scientific methods would effect would be the avoiding of trade slumps by the adjustment of prices and the avoiding of labour troubles by giving the arduous tasks to all the young men and women irrespective of rank.

At times when trade is supposed to be good, things are sold at three or four times the price paid to the people who make them, and as a consequence the people who make them cannot buy them, so there is a slump in the market. This is the main reason why there is so much unemployment and want in the United States, where food, raw materials, capital equipment, and everything for the production of wealth is in abundance. If prices were adjusted so as to cover the exact cost of manufacture and distribution, then the people concerned in the manufacture and distribution would receive enough money to buy them. They would make more and buy more, and wealth would increase. But the slightest illegitimate profit renders it impossible for the people who make the things to buy all that they have made. The demand necessarily becomes smaller and smaller, and wealth decreases.

Prof Walker suggests that the Government should found an experimental self-supporting colony under the auspices of engineers, scientific workers, and economists. The object in view would be to ascertain how far it is possible, with our present knowledge and the best methods of manufacture and distribution, for a group of, say, a hundred thousand persons to maintain themselves and to increase continually their wealth when freed from the restraints and social errors of modern civilisation. Such an experiment might do more to enlighten the world as to the possibility of modern logical methods than an experiment carried out on a continent thousands of miles across, where unforeseen difficulties might easily defeat the best intentions. If we ask what differences there would be in the old world and those of the new colony from which so much is to be hoped, Prof. Walker, in partial answer, would draw two pictures. One is that of a feeble man of sixty years working all day in a sewer, because it is the only occupation he can find to earn his daily bread. Far worse, to him, than the unpleasantness of the task is the rankling injustice that he should be compelled to do this job for no more reward than a living wage, while others with easier tasks get greater rewards. The other picture is that of a young man of twenty-three years, who has chosen the task of sewerman in the spirit of those who went to the trenches in 1914. 'Sir Sewerman', aided by modern appliances, cheerfully puts in his three hours of unpleasant work, and for the rest of the day disports himself and extends his education.

So with all the work of mankind; it can be done cheerfully when justice seasons its incidence.

The Development of Archæology

The subject of Dr. D. Randall-MacIver's presidential address to Section H (Anthropology), is "The Place of Archæology as a Science and some Practical Problems in its Development". It is a very happy and propitious moment for the discussion of the place of archæology as a science and the practical policy which we ought to pursue in view of its startling and wide development. We need to devise methods of organisation, to think out means of collaboration, and to subdivide the field of our activities so that they may all be related in a conscious scheme.

Archæology is very closely related to anthropology; but, whereas anthropology is the wider of the two, the interest of archæology is solely in those works which can only be produced by man when he has become more or less *sapiens*. Without anthropology, however, archæology would be blind in one eye and very short-sighted in the other. What archæology discovers is the bare fact; it can never divine the essence of the fact, which gives it all its meaning and interest. For the whole meaning and rationale of man's life we are necessarily dependent on either anthropology or history.

Documentary evidence is very limited in its range, and although occasionally it usefully supplements our anthropological knowledge, its principal and indispensable function is that of affording a time-scale, which cannot be provided from any other sources. For the immeasurably remote periods of prehistory, geology provides a rough time-scale, which, however, is steadily being improved. About 3500 B.C. this clumsy instrument can be replaced by a much finer one derived from inscriptions and documentary evidence. This is the period of protohistory. But archæology does not end where history begins; and all through the

classical periods of Greece and Rome, and all through the Middle Ages, history needs and receives the greatest assistance from archæology.

Turning to the organisation of archæology, this may be treated under three heads: the collection and recording of the material; the housing, conservation, and exhibition of it in museums; and the comparative study of all such material and the digesting and disseminating of the results in books.

As to the policy and necessities of the science in the collection of the material, there are one or two axioms which once were generally ignored. Of these the most important is that no person who is not qualified by special knowledge and study should ever be allowed to excavate at all, with the corollary that the excavator should be accredited by a properly constituted institution or committee. The looting of sites for the profit or amusement of a private individual will never be allowed again by any government. It ought to follow that digging for antiquities even by the owner of an estate should be forbidden. It is to be regretted that there is no scientific League of Nations, to which we might appeal for protection against powerful interests, whether individual or political.

It is the duty of the explorer to study and record whatever he finds. It is not quite so invariably part of his creed that he should publish, and that quickly and fully. Nothing—no display of plans, photographs, etc., however elaborate—can take the place of publication. A further principle is that a portion of every site should be reserved for future study. The wisdom of one generation, even our own, is unable to foresee all possible problems.

The archæologist's activities in museum work are to a great extent governed by considerations of space. It is said that the public does not want museums; but granted certain exceptions, this is the fault of the museums, in which the visitor is left to drown in an uncharted sea.

In regard to the dissemination in books of the knowledge gained by excavation, the original scientific account is written for the professional and should give a precise account of every stage of the excavation; but when the seed has been gathered and sown, it has to be watered. The semi-popular account may be undertaken by the original explorer or others. Lastly comes the general synthetic works of the writers who manufacture our fine fabrics out of the raw material; for the most striking thing in the archæology of recent years is its sudden co-ordination. The ancient world now appears as a connected whole; while time, thanks to the work of Sir Arthur Keith, Prof. Elliot Smith, and others, has shrunk no less than space. In this synthetic work, however, although the archæological imagination may find play, it must adhere to types of reason which may be regarded as conditionally valid.

Theories in Psychology

In the first part of her address to Section J (Psychology), entitled "Current Constructive Theories in Psychology", Prof. Beatrice Edgell refers to the tercentenary of the birth of John Locke on Aug. 29, 1632. His "Essay Concerning Human Understanding" is primarily a theory of knowledge, but is full of psychological interest and rich in illustrations which would now figure as child, animal, or comparative psychology.

At the time at which Locke wrote, it was impossible for a writer to draw the distinction between a logical analysis of knowledge and a genetic account of knowledge in the individual and the race. Locke's 'simple' idea stands sometimes for an ultimate constituent of knowledge, for a category of the understanding, and sometimes for primitive sensory experience; consequently his 'plain historial method' is misleading. Side by side with his doctrine that knowledge is the perception of the agreement or disagreement of ideas, Locke left a theory of the chance connexion of ideas by their association in time, a linkage which repetition can so strengthen that it comes to be regarded as 'natural', that is, intrinsic. This theory was only put forward in the fourth edition of the essay, and was given as an explanation of error and prejudice. From it and from the doctrine of simple and complex ideas arose the association school of psychology, which culminated in James Mill's "Analysis of the Phenomena of the Human Mind", 1829.

Implicit in the confusion of logical with psychological analysis and in the disparity of the two unreconciled principles of knowledge, intrinsic relation and temporal sequence or coincidence, lie the lines of cleavage which are clearly manifest in the diverse constructive theories put forward to-day. Behaviourism is association psychology in a physiological garb. Advance from simple reactions to complex conduct is ascribed to 'conditioning', and conditioning turns on the sequence of stimuli. Psycho-analysis likewise relies on temporal association as a constructive principle, though the theory is grafted on to the root doctrine of the school, the unconscious with its emotions and instincts. The method, which gives this school its name, is not free from the confusion of psychological with logical analysis. *Gestalt* psychology strives to

break away from the atomism characteristic of the association tradition. It detects the baleful influence of a doctrine of elements and compounds both in behaviourism and in the existential school of Titchener and his followers. In place of sensations as simple elements, the *Gestalt* psychologist recognises sensory patterns as simple wholes (*Gestalten*). In place of association, it preaches 'organisation'. The Neogenetic principles, put forward by Prof. Spearman as basic for any theory of psychology, assert, in agreement with Locke's definition of knowledge, that all knowing is a knowing of relations.

These divergences of theory are to be welcomed. Advance may be looked for not in the victory of one theory or method over all others, but in the discovery of the sphere appropriate for each. Every theory is recognising some aspect of truth. Adherence to a particular school ought not to blind a psychologist to an aspect of fact for which a rival theory offers a more adequate explanation.

In the second part of the address this thesis is illustrated by data from some experiments on memory recall.

Growth Processes in Trees

Many recent studies of growth in trees have added considerably to our knowledge of the various activities closely connected with arboreal development, and such considerations formed the basis of Prof. J. H. Priestley's presidential address to Section K (Botany) entitled "The Growing Tree".

One important recent discovery is that growth each season begins in the bud, whence it spreads downwards over the rest of the tree. These buds, of course, produce new shoots which grow in length, while the older branch systems thicken. Thus, growth in length and growth in thickness (radial growth) are intimately connected. Radial growth is dependent upon the activity of meristematic cambial cells, and this cambial activity only begins as the buds commence growth and then spreads downwards from the base of the buds. For this reason, when pruning, the stem should be cut just above a bud, for if a long piece of stem be left above a bud, since the cambium in it cannot resume activity, this stem withers to an unsightly projection.

The activities underlying growth and development are of importance in the comparison of the hardwood and softwood trees. The hardwood are dicotyledonous (Angiosperms), whereas the softwoods are chiefly coniferous (Gymnosperms). In softwoods, with the 'Christmas tree' habit of branching, radial growth begins below the buds and spreads downwards, but the lower and more shaded the branch, the slower radial growth activity spreads down it. Therefore cambial activity in the main trunk around the bases of the lower branches begins before it does on the branch bases themselves. Thus the old wood of the branch becomes gripped in the new wood of the trunk without actually becoming joined to it. Only later, as cambial activity on the branch begins, do branch and main axis join in forming a common sheet of wood. Therefore, in a thin softwood plank, the wood of the branch may lie loose in the wood of the trunk and knots may even fall out. In the hardwood, branching is by no means so regular, and cambial activity at a branch base begins about the same time as that of the main axis on the same level. Thus a common layer of new wood is formed at the beginning of renewed growth activity, with the result that knots in a plank of hardwood are fixed firmly in the matrix of main-stem wood.

Differences in the microscopic structure of softwoods and hardwoods are closely connected with differences in cambial activity. The cambium cells in the softwood are very long and thin with pointed ends. All new cells cut off from them are similar, very long cells, which expand, by absorbing water from the old wood, with great regularity, all cells in the same zone differentiating at the same time and in the same way. The result is the formation of a very regular woody tissue consisting only of narrow pointed tracheids. In the hardwoods, the cambium cells are much shorter and have relatively transverse end walls. The new tissues derived from this cambium have similar cross walls, and when these short cells expand with water, great strain is thrown upon these cross walls. A new 'strip' method of studying the development of these tissues has shown that as these cells expand, the cross walls collapse in some of the young cells. These cells immediately expand very widely; the walls then break down almost simultaneously in long files of cells in vertical continuity, and the result is the formation of vessels. This rapid expansion of cells in vertical files in the new tissues leads to a diversified structure in the wood finally formed. As the vessel segments expand, they compress cells around them, which are still in a plastic stage, and later form pointed fibres longer than the cambium cells from which they were originally derived. The differences in hardwood and softwood anatomy can thus be traced very largely to the original

difference in length of the cambium initials from which these tissues are derived.

These characteristic growth processes necessarily have a direct bearing upon such problems as the movement of water in the wood and the translocation of food materials in the bast. Water is attracted by osmotic forces into the growing regions around the cambium and the buds. The old wood acts as a water reservoir. But the water is withdrawn more quickly than it is replaced, especially as transpiration from the expanding foliage becomes vigorous. The result is a state of tension, first in the outermost part of the old wood, then in the first formed elements of the new ring of wood. This tension is usually regarded to-day as sustained by liquid columns in the tracheal elements. But experiments are described in which liquid rushes up these tracheal elements when they are immersed and cut open, which suggests that many of the tracheal elements contain nothing but water vapour. In this way wood can be injected to great vertical distance in a very short time, if the liquids, like water, can pass the cross walls. This fact may not be without its practical application where trees have to be killed completely, as in clearing belts of country against the tsetse fly in tropical Africa.

Present-Day Teaching of Elementary Science

At the outset of his address to Section L (Educational Science) Mr. W. M. Heller discusses the functions of the Section. A generation ago it concerned itself with the place and character of school science, but of late years it has adapted itself to the study of the embryonic development of a science of education. He considers it more useful to record the convictions that remain from long contact with problems of teaching, inspection, and administration than to venture into the field of general educational philosophy. He sees great increase in the machinery of school science, but has grave doubts as to the design and efficiency of the machine. In elementary education we have not yet taken science seriously, and in future we must regard it as of the same fundamental importance as the three R's.

Curricula and methods are dominated still by men of unpractical upbringing and with little knowledge of or sympathy with the possibilities of scientific method and thought. Ignoring the change in the position of the mass-centre of human knowledge that has occurred during the past century, a blind faith persists in the grammarian tradition based upon a false and narrow conception of culture.

Without neglect of mental and æsthetic development, education must, in the broad sense, be directly and indirectly vocational. We must cater for the boy and the girl leaving school at fourteen, at fifteen, and at sixteen years of age, and must endeavour to place them in a position to face with success the employment and the problems that will confront them. No general school examination can direct usefully the various types of training necessary. The yoke of examination appears to hang more heavily than ever upon the shoulders of the teachers, who patiently accept the burden as part of a preordained scheme of things. In the years that need greatest concentration upon those aspects of training that no ordinary examination attempts to test, the evil spirit of external examination has obtained a stranglehold upon the efforts of both teacher and pupil. The problem of external examination is not unsolvable, but it must be faced with courage, and we must trust our teachers. Internal examination associated with sufficient and constructive inspection can provide every safeguard that the public can demand.

The term 'heuristic method' should be discarded, owing to the intemperate and destructive criticism that has centred around it; but tribute should be paid to the inspiration of Prof. H. E. Armstrong, who almost alone during the past fifty years has helped educationists to put purpose and method into their work. The term 'natural method' is adopted as less open to misinterpretation than 'heuristic method'. A broad course of general science is essential; the artificial barriers between subjects set up for the convenience of external examinations must be broken down, the teacher must be free, if necessary, to touch half a dozen sciences in one and the same lesson. The lack of progress in general science is due to the narrow specialisation of students in the university, and this is reflected in the schools by the absence of useful and vocational purpose. The training of the future science teacher needs radical change, and more deliberate purpose; he should be able to teach efficiently any section of a general science course; he must be a far more handy-man in every sense of the word than the present university output provides.

The historical and philosophical treatment of education does not produce practical and resourceful teachers, and theoretical training would be more effective if undertaken after some years of thoughtful experience. The art of teaching must develop

along inductive lines; we must concentrate upon a product equipped to gain knowledge from experience and conscious that success in his art can be achieved only by his own investigation.

Less advance has been made in domestic science than in other practical studies. Domestic duties call for more intelligence, knowledge, and initiative than do the vocations followed by boys. The academic courses that boys usually follow make little appeal to girls. There is need for better correlation between the teaching given in the laboratory and the kitchen, and we shall not get the best out of either of these aspects of domestic science until both are taught by one and the same person. Neither the university nor the domestic training school are turning out the right type of teacher.

The address of the previous occupant of the Section's chair at York—Sir Michael Sadler—recalled the traditional ruts in which education moved, the concentration upon book-learning, the neglect of handwork, and our wastefulness of the more ordinary kinds of intellectual material, which were regarded by Sir Michael as the besetting weakness of the time. He deplored the worship of examinations as destructive of teaching and learning alike; but he did not foresee the extent to which machine-made examination would divert from its proper purpose the major part of our educational effort.

Sheep Farming in Great Britain

Sheep farming is usually associated with ranching systems in zones beyond the areas in which cultivation and dairying are economically possible. Yet Great Britain occupies about the eighth place in a list of the countries of the world arranged according to total number of sheep, and it is only surpassed by New Zealand as regards density of sheep population. The great importance of this branch of British agriculture forms the basis of Prof. R. G. White's presidential address to Section M (Agriculture), entitled "Sheep Farming, a Distinctive Feature of British Farming". Compared with other European countries, we have many times the number of sheep per unit area of agricultural land.

This special importance of sheep is no new feature of British agriculture, and it has had profound effects on our national life as well as on our agricultural organisation. During the Middle Ages, continental manufacturers looked to Great Britain for their supply of wool, just as the Yorkshire manufacturer now goes to Australia. Until the latter half of the eighteenth century, wool production was much the most important function of the national sheep flock. Meat production became more important during the eighteenth century, when the demands of the increasing urban population and the introduction of roots and clover altered the whole basis of British agriculture. During the last thirty or forty years there have been great changes, largely resulting from the development of the fat lamb industry, but also in great measure due to the low prices of grain.

These changes have resulted in great modification of the composition and distribution of our flocks. On light land in the south and east of England, 'arable sheep' managed on a very intensive system play an important part in maintaining the fertility of the soil for corn growing. So much land has been laid down to grass, or is now cultivated on a different system, that the total sheep stock in these areas has been reduced by more than fifty per cent. Although there have been large increases in other districts, for example, North Wales and the east of Scotland, they by no means provide full compensation for the loss. To a very large extent, our sheep stock consists now of hill breeds and their crosses, which are kept on an extensive system involving little outlay on labour, feeding stuffs, or permanent equipment. Their substitution for arable farming has brought about a general decline in the life of the countryside.

On the other hand, at the present time sheep provide the only possible way of utilising the large areas of hill land economically, and an outlet for the draft ewes and store lambs is essential. Moreover, grass sheep, managed in such a way as to meet present demands, fit in well with grass production, for which the climate makes the greater part of Great Britain best suited.

Possible developments include a consideration of the practicability of securing a greater return per unit of the flock; possible changes in management and functions; and the highly controversial question of the need for maintaining our great number of different breeds. The diseases of sheep are of great importance to flock management, and in this connexion there is an urgent need for more research.

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application, and no injury to any of the plants was observed. Although no special apparatus is essential, the following method for distribution is suggested. A water suction pump (ejector) is attached to the garden tap, and hose piping leads from the suction opening into the barrel containing ammonium sulphide solution. The distributing hose is connected to the other end of the filter pump. On turning on the tap, the solution is drawn off from the barrel, mixed with water from the tap, and forced through the distributing hose. Calculation and trial are of course needed to determine the strength of ammonium sulphide solution in the barrel in order to yield 1 part in 30 in the distributing hose. Mr. Van Riper would welcome the reports of other experience in the use of this method for slug eradication.

Narcissus Pests

BULLETIN No. 51 of the Ministry of Agriculture and Fisheries (May 1932), entitled "Narcissus Pests", by Mr. W. E. H. Hodson, has recently come to hand. The object of this publication is to provide growers with reliable and up-to-date information enabling them to control the more common and destructive of the enemies of the narcissus. The Bulletin deals with the species of flies of which the larvæ are persistent enemies of the bulbs, while eelworms, mites, and other pests are also fully discussed. The most satisfactory treatment for all such pests is the submersion of the bulbs in water maintained at a temperature of 110° F. for three hours. If such treatment were not available it is highly probable that the bulb eelworm would by now have rendered commercial growing almost impracticable. The Bulletin is obtainable, price 1*s.* net, from H.M. Stationery Office or through any bookseller.

Penguins' Eggs

THE appearance of the eggs of penguins in some of the large London stores, where they were sold as epicurean novelties at ten shillings a dozen, led the Royal Society for the Protection of Birds to make inquiries regarding the source and supply (*Bird Notes and News*, vol. 15, No. 2, p. 39, 1932). The eggs were those of the Cape or black-footed penguin (*Spheniscus demersus*), and were obtained in one of the extensive penguin rookeries in the Cape Province of the Union of South Africa. The eggs were collected for sale under Government regulation, and the Trade Commissioner for South Africa informed the Society that during the months of April and May of the present year some 2000 dozen of the eggs were exported to Great Britain. We hope that the Government department which regulates the taking of the eggs will see to it that the strength of the penguin colony is not too seriously reduced, remembering the fate of the gare-fowl when commerce invaded its innumerable hordes; and we trust that the exceptional opportunity will be taken of associating the statistics of eggs taken with the total strength of the colony year by year, for the study of the effect upon the population of the colony as a whole.

Monument to Laplace

THE issue of *Revue Scientifique* for Aug. 13 briefly records the inauguration on July 3 of a monument to the great French mathematician, Laplace, at his birthplace, Beaumont-en-Auge (Calvados). The monument, which is the work of M. R. Delandre, has been erected by international subscription, among the principal contributors to which were Messrs. J. H. Fry and J. Flanagan, of the United States, and the two Carnegie Foundations for Science and Peace. The unveiling took place in the presence of Maréchal Franchet d'Esperey, of the Société de Géographie of Paris, and distinguished representatives of the Academy of Sciences, the Paris Observatory, and the École Polytechnique. As recorded in NATURE for April 2, 1927, p. 493, at his death in March 1827 Laplace was buried in the Père Lachaise cemetery in Paris, but sixty-one years later, in 1888, his remains were exhumed and reinterred in the grounds of the family estate at the little hamlet of Saint Julien de Mailloc, situated between Lisieux and Orbec (Calvados). At the time of the reinterment, the monument which had marked the resting-place of Laplace in Paris was presented to the commune of Beaumont-en-Auge, and was re-erected in the cemetery there.

Discovery of the Deviation of the Compass

IN the July issue of *Science Progress*, Mr. N. H. de V. Heathcote brings together the data at present available for fixing the date of the discovery of the deviation of the compass from true north. The figure in the instructions of the Nautical Chart of Bianco of 1436 which has been taken as evidence that a correction for a deviation of 18° west of true north was allowed for, the author concludes has nothing to do with deviation. The first definite record of deviation he considers to be that made by Columbus in September 1492, during his first voyage across the Atlantic. In his record of his return in 1496 from his voyage to India, Columbus mentions Flemish compasses which read $11\frac{1}{4}$° west of north when the Genoese compasses read north. Mr. Heathcote points out that pocket sundials were in use in Germany about the middle of the fifteenth century which were set in the meridian by a compass; in the latter an allowance for a deviation of 6° east of true north was made, while in Etzlaub's road map of Germany of 1492 instructions are given for orienting it correctly by compass, an allowance for deviation of $11\frac{1}{4}$° being made. He concludes that pocket sundials with an arrow set $11\frac{1}{4}$° east of north were familiar objects in Germany before the time of Columbus.

Bibliography of Line Spectra

No better comment could be made on the present importance of line spectroscopy than the publication by the American Physical Society in *Reviews of Modern Physics* (April) of a bibliography of the papers which have appeared between 1920 and 1931. This has been compiled by R. C. Gibbs, and is prefaced by a short elementary account of the interpretation of spectra. The bibliography is divided into three sections. The first, which contains the majority of the references, is a list of those papers which contained new data or discussions; these are divided according to elements, stage of ionisation, year of publication, and alphabetical order of authors, and in general, when one paper has dealt with several elements, it

has been listed under each to avoid cross-references. The two other sections are much shorter, and deal with more general publications, articles mainly concerned with the mathematical machinery of quantum mechanics not being included. The lists occupy some 150 pages of small print, and although essentially uncritical, should be of the utmost value to all workers in spectroscopy.

Progress in Modern Physics

IN his introduction to a set of pamphlets on recent developments in physics ("Exposés de physique théorétique") published by Hermann et Cie, of Paris (6 francs each), Prof. L. de Broglie raises once more the question of how contact can be maintained between workers at different branches of physics. It is now quite impossible for any one person both to read critically all new papers, in any but a most limited field, and to advance the subject himself. Realisation of this is, of course, not new, and has inspired, amongst other publications, the American Physical Society's *Reviews of Modern Physics*. The present series seems likely, however, to fulfil its purpose better than anything that has gone before. Although definitely for advanced workers, the articles are anything but abstracts, being well written and critical, and containing adequate detail without providing what is really irrelevant to anyone not a specialist in the particular subject dealt with. They also deal with relatively new or very recent work. Of the two at present under notice, Prof. de Broglie's is based on Landau and Peierl's treatment of the uncertainty principle (*Z. Phys.*, vol. 69, p. 56), and is purely theoretical. The other, by Irène Curie and F. Joliot, is an account of the neutron experiments, particularly those done by the workers in Paris; it contains an interesting set of reproductions of Wilson cloud trails, which supplement those recently published by Feather and Dee in the *Proceedings of the Royal Society*. Each article occupies a little more than twenty pages, and although attractively presented, is certainly cheap.

Cadastral Survey and Land Records

DURING the Conference of Empire Surveyors held in London last year, there was exhibited at the Science Museum a number of cadastral survey, land registry, and land revenue records. The Royal Geographical Society, at the instance of the Secretary of State for the Colonies, has arranged to house these exhibits, and hopes to make them the nucleus of a permanent reference collection in London. It is expected that the collection will include land laws, regulations, and technical instructions from all parts of the world, and will be representative of progressive advances in cadastral survey and land records in each country. Sir Ernest Dowson and Mr. V. L. O. Sheppard have jointly undertaken the collection, study, and maintenance of the documents.

Oil Fuel for Horticultural Purposes

THE seventeenth annual report (1931) of the Cheshunt Experimental and Research Station contains a short account of a test with an automatic heating installation using oil fuel. A thermostat in the tomato greenhouse controls the action of a crude oil burner which gives heat to a special hot-water heating boiler. The account is quite short and the experiment incomplete, but the results show that an enhanced yield can be expected from the increased night temperature. Moreover, the fungus disease known as tomato leaf mould was kept in check by the higher temperature.

Announcements

THE thirty-sixth autumn fungus foray and annual general meeting of the British Mycological Society will be held at Haslemere, Surrey, on Sept. 19–24. Miss G. Lister will deliver the presidential address, entitled "Field Notes on Mycetozoa", on Sept. 21. Several interesting local excursions have been arranged in connexion with the meeting

THE Society of Biological Chemists (India) has made itself responsible for an interesting pamphlet, "Biochemical and Allied Research in India in 1931", in which in about forty pages Indian biochemical research in different fields is summarised in a series of brief reviews by some six contributors. The papers cited, of which the majority appear to have been published in 1930 and 1931, number no less than 181. These brief summaries are grouped under various sub-headings—for example, enzymes and fermentation, agricultural chemistry, chemistry of nutrition, etc.—and seem to be very concisely done, so that this little pamphlet should be useful to many biochemical workers outside India.

THE Society of Petroleum Geophysicists (America) has issued volume 1 of its *Transactions*, comprising a series of important papers presented by the Society at the annual convention of the American Association of Petroleum Geologists at San Antonio in March 1931. Most, if not all, of these papers have appeared in the *Bulletin* of the Association, but now they are available in a convenient, compact form. The titles are: "Application of Seismography to Geological Problems", by E. McDermott; "Belle Isle Torsion-Balance Survey", by D. C. Barton; "Some Results of Magnetometer Surveys in California", by E. D. Lynton; "Magnetic Disturbance caused by Buried Casing", by W. M. Barret; "Brunton Compass Attachment for Measurement of Horizontal Magnetic Intensity", by J. H. Wilson; "Utilization of Existing Wells in Seismographic Work", by B. McCollum and W. W. La Rue; and an "Analysis of some Torsion-Balance Results in California", by R. H. Miller. The editor is F. H. Lahee, and an introduction has been written by G. H. Westby. The volume can be obtained in England from Messrs. Thomas Murby and Co.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A male junior assistant (chemistry) at the Experimental Station, Porton, near Salisbury (War Department)—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1 (Sept. 12). A chief workshop instructor in the Mechanical Engineering Department, at the Northampton Polytechnic Institute, St. John Street, E.C.1—The Principal (Sept. 15).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Photography of Penetrating Corpuscular Radiation

SINCE Skobelzyn [1] discovered the tracks of particles of high energy on photographs taken with a Wilson cloud chamber, this method has been used by him and others in a number of investigations [2] of the nature of penetrating radiation. Such work is laborious, since these tracks occur in only a small fraction of the total number of expansions made. We have found it possible to obtain good photographs of these high energy particles by arranging that the simultaneous discharge of two Geiger-Müller counters due to the passage of one of these particles shall operate the expansion itself. On more than 75 per cent of the photographs so obtained (the fraction depending on the ratio of the number of 'true' to 'accidental' coincidences) are found the tracks of particles of high energy.

Mott Smith and Locher [3] had previously found a correlation between the occurrence of these tracks and the discharge of a tube counter, and recently Johnson, Fleicher, and Street [4] have used the coincidence of the discharges of two counters to operate the flash which illuminates a continuously working cloud chamber.

The chamber we used has a diameter of 13 cm. and has its plane vertical, with one tube counter above and one below, so that any ray which passes straight through both counters will also pass through the illuminated part of the chamber. A magnetic field is applied at right angles to the plane of the chamber. When the cloud chamber has been made ready for use, the arrival of a coincidence is awaited. After an average wait of about two minutes, a coincidence occurs and a relay mechanism starts the expansion.

The tracks have a definite breadth due to the diffusion of the ions during the time between the passage of the ray and the attainment of supersaturation. The chamber was designed so that this time

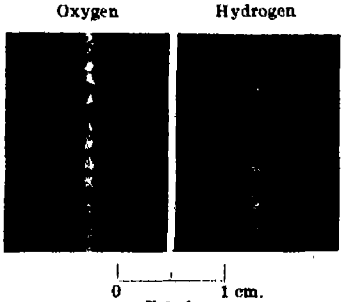

FIG. 1.

should be very small; it was in fact 0·01 sec. The observed breadth of the tracks in oxygen at 1·5 atmospheres pressure was 0·8 mm., and in hydrogen 1·8 mm. (Fig. 1). These breadths are in close agreement with the values calculated from the theoretical relation $\overline{x^2} = 2\,D\,T$, giving the mean square displacement in terms of the diffusion coefficient and the time. In spite of this breadth, the tracks in oxygen are admirably suited for accurate measurement.

The method is very economical in time in comparison with the usual method. Though the track of a fast particle may be obtained every tenth random expansion, only a few of such tracks are of use if an accurate determination of the energy of the particles is to be made. For this purpose it is desirable that a track shall lie in the plane of the chamber, for this ensures that it will be long, in perfect focus, and at right angles to the field. The fraction of random expansions which show such tracks is very small. Again, it is easier to adjust a chamber to take a few good photographs than it is to maintain the adjustment while taking many thousand.

The method has one disadvantage. The technical problem of obtaining a very large magnetic field over the whole chamber, such as has been obtained by

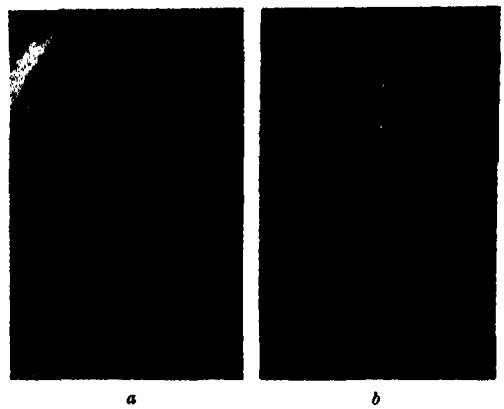

FIG. 2.—Tracks of high-speed particles. (*a*): $H\rho$ about 68,000 gauss cm., corresponding electron energy 20×10^6 volts; (*b*): $H\rho$ probably about 2×10^6 gauss cm., corresponding electron energy 600×10^6 volts.

Millikan and Anderson, is difficult, since the field must be maintained for periods of some minutes, while, when making expansions at random, it is only needed for a fraction of a second.

Among one hundred stereoscopic pairs of photographs, 59 showed the track of a single high speed particle passing through both counters (Fig. 2, *a* and *b*); 17 showed either multiple tracks of varying degrees of complexity, such as have been found by other workers, or else a single track passing through one but not both counters; 24 showed no tracks. Only about ten per cent of the tracks were markedly bent in a field of about 2000 gauss. Assuming them to be electrons, their energies lay between 2 and 20 million volts. To estimate the energy of the particles producing the main group of nearly straight tracks, the angular resolving power of the apparatus was determined by measurement of tracks obtained with no magnetic field. It was found in this way that a *mean* deviation of ½° could be considered as significant. Since the tracks obtained with the magnetic field of 2000 gauss showed no such deviation, it was concluded that the *mean* $H\rho$ of these particles must have been greater than 2×10^6 gauss cm. If the particles were electrons, their *mean* energy must have been greater than 600 million volts, or if protons, greater than 200 million volts.

P. M. S. BLACKETT.
G. OCCHIALINI.

The Cavendish Laboratory,
Cambridge,
Aug. 21.

[1] Skobelzyn, *Z. Phys.*, **54**, 686; 1929.
[2] Skobelzyn, *Comptes rendus*, **194**, 118; 1932. Auger and Skobelzyn, *Comptes rendus*, **189**, 55; 1929. Millikan and Anderson, *Phys. Rev.*, **40**, 325; 1932.
[3] Mott Smith and Locher, *Phys. Rev.*, **38**, 1399; 1931: **39**, 883; 1932.
[4] Johnson, Fleicher, and Street, *Phys. Rev.*, **40**, 1048; 1932.

Intensity of Cosmic Radiation in the High Atmosphere

ON Aug. 12, I succeeded in measuring the intensity of cosmic radiation in the high atmosphere, at air pressures down to 22 mm. of mercury, by means of two rubber balloons and a self-registering electrometer. The electrometer was working on the same principle

FIG. 1.

as that used for the investigations in Lake Constance.[1] The position of an electrometer wire is photographed every four minutes on a fixed photographic plate. The volume of the ionisation chamber was 2·1 litres, the thickness of its walls was 0·5 mm. The air pressure outside and temperature within the apparatus were

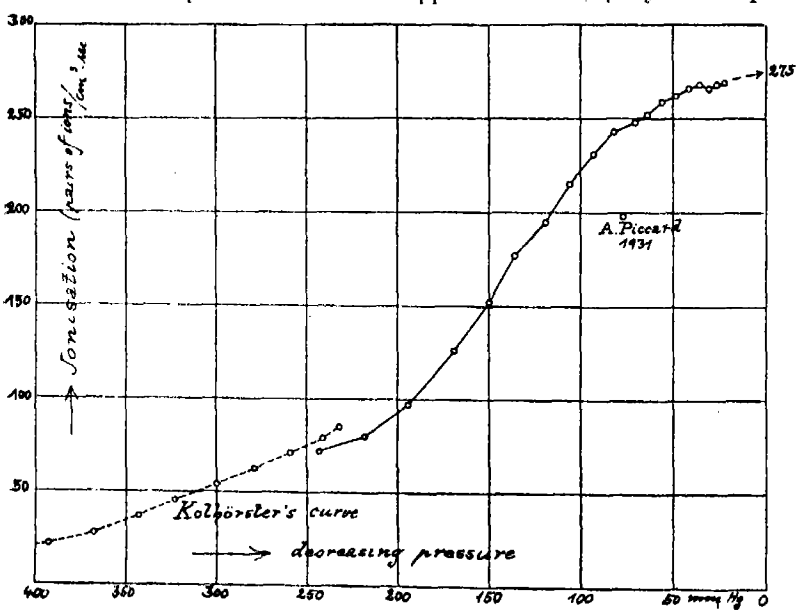

FIG. 2.

measured simultaneously with the electric tension by limiting the length of the wire pictures by an aneroid on one side and by a bimetallic lamella on the other. The apparatus was protected against the low air temperature in the stratosphere by a case of 'Cellophane', which catches the sun's rays like a 'forcing-house'. Therefore the temperature inside the apparatus only varied between + 15° and + 37 C°.

Fig. 1 is a reproduction of the results obtained on the photographic plate. At point 1 the apparatus begins to operate, between points 2 and 3 the tension is measured every 4 minutes, after 3 one of the balloons explodes, point 4 shows the landing. Between 2 and 3 the air pressure (upper limit of the wire photographs) varies from 243 to 22 mm. of mercury.

Fig. 2 shows the results from this plate together with the end of the corresponding curve of Kolhörster and the value obtained by A. Piccard in 1931.[2] The intensity I of the cosmic radiation (I = pairs of ions per cm.^{3} sec.) is given as a function of the decreasing air pressure (in mm. of mercury). The following results may be derived from this curve :

(1) Below 150 mm. mercury (that is, above a height of about 12 km.) the intensity of cosmic radiation increases less rapidly as one approaches the end of the atmosphere.

(2) At lower pressures the intensity approaches rapidly its highest value. Therefore it is possible to extrapolate the intensity of radiation at its entrance in the atmosphere. One gets a preliminary value of 275 I., provided that the intensity does not pass through a maximum value and decrease again at greater heights. This might be the case in consequence of result (3).

(3) The cosmic radiation saturates itself with secondary radiation after having entered the atmosphere. If it remained a mere primary radiation, its intensity would decrease much more rapidly at great heights, and the curve of Fig. 2 would have no point of inflection.

(4) There seems to be no γ-radiation of the common radioactive bodies in outer space. Otherwise it would give rise to a new increase of intensity in the highest parts of the curve, as about 20 per cent of the common γ-rays would pass through a layer of air corresponding to a pressure of 22 mm. of mercury.

Supposing air temperature is constant and equal to 0° C., a height of 28 km. corresponds to a pressure of 22 mm. of mercury.

A more detailed report of the investigation will be published shortly in *Die Naturwissenschaften*.

E. REGENER.

Physical Institute of the
Technical High School,
Stuttgart, Aug. 20.

[1] Z. Phys., 74, 433 ; 1932.
[2] *Naturwissenschaften*, Aug. 5, 1932.

The α-Rays of Ionium

THE differential method of Lord Rutherford for counting α-particles may of course be used, and with great advantage, for the measurement of the ionisation current. It gives the differential of the ordinary Bragg curve, the variation of the ionisation from element to element of distance, rather than the total ionisation for the element.

I have constructed an apparatus for this purpose capable of considerable accuracy, and the results so far obtained in calibrating it with the α-rays of polonium and ionium have features difficult to interpret. It has three ionisation chambers, 1·85 mm. deep, separated by aluminium leaf equivalent in stopping power to about 1 mm. of air, the one nearest the source being a guard chamber, and the current

through the middle chamber being opposed by that through the posterior chamber. The depth of the latter can be varied by screw adjustment, and, in use, it is set so that the currents balance, with polonium as the source of α-rays, at the beginning of the effective range. The pitch of the screw was $\frac{1}{25}$ in. (1·016 mm.).

The first curves obtained with polonium and ionium are shown in Fig. 1, with the experimental points indicated by circles. Rosenblum has shown by magnetic analysis that the α-rays of polonium are

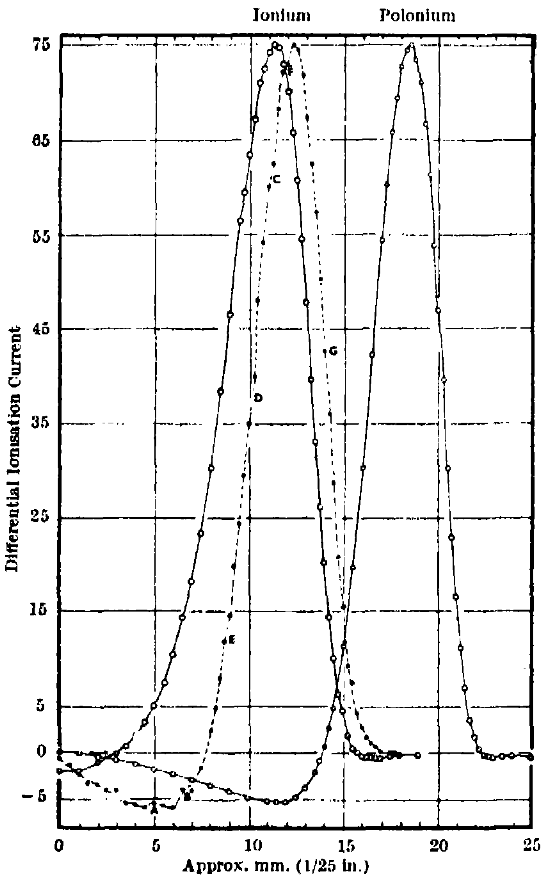

FIG. 1.

homogeneous, and the curve may be taken as that for homogeneous α-particles. It will be seen that on bringing up the preparation from a distance, the current, after rising to a maximum and falling to zero, changes sign and passes through a minimum before reaching zero again at the beginning of the effective range, for which the chambers are balanced. At greater distances, so long as all the rays traverse both chambers, the current in the posterior one predominates, through the increase in ionising power towards the end of the range.

The ionium curve corresponds very closely with that for polonium, so far as the right limb is concerned, but departs markedly for the left limb. The slope is more gradual, and no actual minimum is reached. Also there is a clear inflection at about 2 mm. from the maximum, as though rays of shorter range were present. The ionium employed was an ionium-thorium oxide, prepared by Miss Hitchins and myself from St. Joachimsthal pitchblende residues, and shown, from the rate of growth of radium, to contain ionium and thorium in the ratio 53 : 47.[1] It was finely powdered, and 5 mgm. spread as evenly as possible on a disc 5 cm. in diameter. For a uniform layer, the equivalent stopping power would have been about 1 mm. of air.

To determine the effect due to absorption in the film, another, containing only about 1 mgm. of ionium oxide, was made by evaporating and igniting a solution of the nitrate. Owing to the reduced activity, the curves could not be taken with so great accuracy as before, especially in the neighbourhood of the zero. But all the curves obtained agreed in their main features and differed distinctly from the polonium curve. The mean of the results for the three most complete curves is shown by a dotted line in Fig. 1, the black dots being the experimental points for the most extended single set of measurements.

The minimum is now more pronounced than for the polonium curve and shows definite irregularities at points marked *A* and *B*. The inflection on the left slope in the first curve is marked *C*, and three others are indicated at *D*, *E*, and *F* on this branch, with another at *G* on the right branch. Though small, they appear to be real.

The curves in the figure are not reduced to standard temperature and pressure, but the first two refer to nearly standard conditions. The difference in range between the two ionium preparations is due, one-third to the dotted curve being taken with a lower barometer and higher temperature, and two-thirds to the effect of absorption. Conformably with this, while the corrected ranges found from the two full curves agree with the values usually accepted, 3·87 cm. and 3·195 cm. respectively, the more accurate value for ionium, obtained from the dotted curve, 3·22 cm., is about 0·25 mm. greater than the accepted value.

At first sight it would appear natural to ascribe the irregularities found for the ionium curve to heterogenity of the rays, as found by Rosenblum and others for thorium C, radioactinium and several other 'α-rayers', and to look for a γ-radiation from ionium, which, on Gamow's theory, should be associated with the short range α-rays. I do not think ionium is known to give a γ-radiation, but all my preparations show a detectable penetrating radiation, more penetrating than β-rays, which, though small, is in excess of that due to contained thorium.

Unfortunately, however, for this explanation, the ionium curve obtained for the weaker preparation is distinctly less broad than that for polonium. A careful comparison of the reduced curves showed the latter to be from 0·3 mm. to 0·4 mm. the broader over the lower positive part of the curve. This, owing to straggling, is what is to be expected for the longer range rays of polonium, *if those of ionium are homogeneous*. If the latter were composed of rays of different ranges, this method must reveal it by a corresponding broadening of the curve. The cause of the irregularities thus remains for the present unknown, but more experience with the method may reveal it.

FREDERICK SODDY.
University Museum,
Oxford.

[1] *Phil. Mag.*, 47, 1148; 1924.

The Glow in Photoelectric Cells

MAKERS of photoelectric cells usually state the limits of e.m.f. which can be used, and beyond which a glow discharge sets in. Although I have not met with any explicit statement, it seems to be implied that short of this e.m.f. no glow is visible.

Recently, when using a 'Madza' thin film cæsium cell (made by the British Thomson-Houston Co., Ltd.)

to indicate the intensity of an infra-red beam, I noticed that the cell was visibly luminous. The luminosity ceased when the infra-red beam was intercepted or the electric circuit broken, and is, without doubt, due to excitation of the residual gas atoms (argon) by electronic collisions. There is, of course, nothing radically new in this, since excitation potentials have been exhaustively studied. The novelty, if any, is that here the source of electrons is a photoelectric surface, instead of the hot wire usually employed.

The older types of photoelectric cells were sensitive only to visible light. This would tend to mask the comparatively feeble glow, and thus prevent its being noticed. In my experiments, the beam was infra-red light, isolated by a filter of red glass combined with a thick block of cobalt blue. The source was a small incandescent lamp focused on the cell, and the residual red passed by the filter was almost imperceptible, making it easy to observe the glow.

Some tests were made to observe the minimum e.m.f. for a perceptible effect. The observer's eyes were well rested in the dark. It was found that when the full working voltage of 70 volts or so was applied, glow filled the whole space between the wire anode and the hemi-cylindrical cathode surface. As the voltage was diminished the luminosity shrank, as might be expected, to the neighbourhood of the central wire, since it is here that most of the voltage is dropped.

Careful experiments showed that luminosity could be seen at 15·85 volts but not at 15·75 volts. These observations were made by my assistant, Mr. R. Thompson, whose eyes are younger than mine. I was not myself able to see light at quite so low a voltage. We may take the intermediate value, 15·8 volts, as the minimum for visible luminosity under the conditions. This is very close to the lower of the two ionisation potentials of argon, which, from the optical evidence, should be 15·72 volts. Luminosity should be observable below the ionisation potential, and, in fact, Horton and Davies [1] were able to observe it at 15·1 volts, using the ordinary hot wire source of electrons.

It has seemed worth while to describe this method of observing with the photoelectric cell, because it is easy and instructive, and requires only ready-made commercial apparatus. If a fairly sensitive galvanometer is included in the circuit, the current–e.m.f. relation can be examined at the same time, and it can be seen that luminosity sets in at about the point where ionisation by collision appears.

The method could perhaps be developed for accurate determination of excitation potentials of the various spectrum lines.

RAYLEIGH.

Aug. 18.

[1] *Proc. Roy. Soc.*, A, **102**, 131; 1922.

Influence of Light on the Gorging of *Culex pipiens* L.

IN England the blood-feeding habits of *Culex pipiens* have been subject to doubt. Thus, MacGregor [1] states that "Attention must be drawn to the discrepancies which seem to exist between the habits of the representatives of this species in Britain, the U.S.A., France and elsewhere. For instance, great difficulty is ordinarily experienced in Britain in getting *C.* (*C.*) *pipiens* to 'bite' naturally; so much is this the case that it is even now not generally recognised that the species is a blood feeder in this country." Woodcock, on the other hand, says that "*Culex pipiens* is essentially the British mosquito which likes Avian blood".[2] Hitherto the difficulty of inducing *C. pipiens* to gorge under experimental conditions has been a source of difficulty to workers, and MacGregor [3] says that in his work on avian malaria "an unforeseen difficulty arose in that only a very small proportion of the mosquitoes (*Anopheles maculipennis*, *Culex pipiens* and *Aëdes argenteus*) could be induced to feed on birds".

While breeding *C. pipiens* for work on mosquito infection in avian malaria on behalf of the Medical Research Council, we noticed that light appeared to be an important factor in inducing *C. pipiens* to gorge on canaries. Mosquitoes kept in the dark in a thermostat at 25° C. would seldom gorge, whereas those kept in a glass cage in daylight would gorge readily at dusk. When the cage was illuminated overnight during the winter (with a 60-watt electric bulb), they would gorge, when darkened, at any time during the day. In the summer, prolonged exposure to bright daylight is effective without additional artificial light.

Experiments were then made on the comparative numbers of females which would gorge after having been kept for various periods in darkness and in light. In each experiment all the females were bred from eggs laid the same day.

The experiments were done in a two-compartment cage with glass sides. Each compartment could be darkened completely by sliding shutters. The same number of females were put in each compartment, supplied with water and a slice of apple; and one compartment, *A*, was kept dark, while the other, *B*, was illuminated either by daylight and artificial light or entirely by artificial light. A canary was put into each compartment for about three hours daily after various periods of darkness or light, both compartments being darkened while the birds were in. Any gorged females were then removed and counted.

In one experiment 70 females were put in each compartment. Compartment *B* was illuminated continuously with a 60-watt bulb; while *A* was kept dark for 6 days, and was then illuminated in the same manner as *B*. While compartment *A* was dark, only 2 females gorged, whereas in *B*, which was illuminated, 47 gorged in the same time. Further, after 3 days' illumination, the insects in *A* began to bite, and 48 gorged on the following two days.

In another experiment, 51 females were put in each compartment. Compartment *A* was kept dark for 5 days, during which none gorged; but *B* was illuminated by daylight and artificial light during the same time and 34 gorged. *A* was then illuminated for 8 days and during this time 21 gorged.

In a third experiment with 70 females in each compartment, *A* was kept dark for 7 days, during which 2 gorged; and during the same time 32 gorged in *B*, which was illuminated with daylight and artificial light. *A* was then illuminated for 10 days, and during this time 33 gorged.

The temperature was recorded daily in each compartment, and although it fluctuated about 5° C. with the room temperature, it never varied more than 1° C. between the illuminated and the dark compartments.

We have also observed that the females which gorge after being kept in the dark, if dissected immediately after biting, show more developed ovaries and less fat-body than the females kept in the dark.

Further work on these lines is in progress and will be published in detail elsewhere, but the results already obtained show definitely that, under experimental conditions in England, *Culex pipiens* will gorge readily when placed in the dark after prolonged exposure to light, but if kept continuously in the dark will only rarely gorge. In our experiments, of those kept in the dark, only about 3 per cent gorged, while

after exposure to light 66-90 per cent gorged. To our knowledge, this phenomenon has not previously been observed.

By utilising this method of obtaining large numbers of gorged females, and feeding the larvæ on boiled bakers' yeast, we can breed *Culex pipiens* very successfully under laboratory conditions. About 20 per cent of the egg rafts are fertile, and the mortality from eggs to imagines is not more than 10 per cent. Starting with hibernating females, we have now raised the third generation of imagines, each generation having comprised thousands of individuals.

P. TATE.
M. VINCENT.

Molteno Institute,
University of Cambridge,
Aug. 1.

[1] *Trans. Soc. Trop. Med. and Hyg.*, **24**, 470; 1930-31.
[2] *Zool. Anz.*, **18**, 8; 1914.
[3] *Trans. Soc. Trop. Med. and Hyg.*, **23**, 203; 1920.

Bionomics of *Trochus niloticus*, Linn.

I HAVE been greatly interested in Dr. C. Amirthalingam's communication [1] about the breeding of *Trochus niloticus* in the Andaman Sea. My own statements on the breeding of this species in the waters of the Great Barrier Reef were based on work done by Mr. F. W. Moorhouse, at that time a member of the Great Barrier Reef Expedition and now Marine Biologist to the Government of Queensland. This work has recently been published,[2] and in addition to much information about the habits and growth of this animal, Mr. Moorhouse states that it appears "to be a winter-breeder, the season extending from March to July at least, and each animal possesses a protracted spawning period". During this period the surface temperature of the water round about Low Isles where these observations were made ranged from about a maximum of 28° C. in March to a minimum of about 20° C. in July.

Dr. Amirthalingam does not give any temperature figures in his letter, but states that spawning begins in the Andaman Seas in April when the temperature is near the maximum for the year before the outbreak of the south-west monsoon. He will doubtless give full temperature records in his final report, which, with Mr. Moorhouse's paper, should go far towards the full elucidation of the bionomics of *Trochus niloticus*, information urgently required in view of the great economic importance of this animal.

C. M. YONGE.

Marine Biological Laboratory,
Citadel Hill,
Plymouth, Aug. 10.

[1] NATURE, **130**, 98, July 16, 1932.
[2] Moorhouse, F. W., 1932. "Notes on *Trochus Niloticus*." G. Barrier Reef Exped., 1928-29, Sci. Repts., Brit. Mus. (Nat. Hist.) III., pp. 145-155.

Prevention of Blight in Seed Potatoes

IN Jersey, seed potatoes are usually dug when the haulms are green. If blight (*Phytophthora infestans*) is present on the foliage at this time, serious losses may occur in the seed boxes owing to the fungus spores falling on the tubers at digging-time. Losses of fifty to seventy-five per cent are not uncommon.

Experiments carried out at the States Experimental Station, Glenham, have shown that this loss may be almost entirely eliminated by dipping the 'seed' twice, soon after digging, in a 1 per cent dilution of formaldehyde (1 pint of 40 per cent formaldehyde in 99 pints of water) or in a neutral mixture of copper sulphate and caustic soda (4 : 1¼ (about) : 40). Preliminary trials have indicated that dipped and undipped 'seed' sprout equally well.

The method is being tried on a large scale this year. The tubers are dug, placed in the seed boxes, and taken to the farm the same day, where they are dipped before being stored. Four men are able to unload, dip, and stack 360 boxes of seed in one hour.

T. SMALL.

States Experimental Station,
Glenham, Jersey, C.I.,
Aug. 15.

Sir Richard Threlfall and Sir Horace Darwin

MANY of us have read with much interest the understanding obituaries of Sir Richard Threlfall that appeared in NATURE of Aug. 13. Both obituaries dwell on his inventiveness and powers of work. When looking through some old papers to-day, I found a letter from Sir Richard to his friend the late Sir Horace Darwin. In the course of a conversation on a continuous gas calorimeter, which must have taken place about 1900, Darwin suggested that it was advisable to link up automatically the quantity of water heated by the gas flame with the quantity of gas burnt. Threlfall did this, and obtained a recording calorimeter which was far in advance of any other instrument for many years. The letter was evidently written by Threlfall to Darwin after one of the concentrated periods of work referred to in the first obituary notice. It was accompanied by a clear sketch and notes in Threlfall's handwriting.

"Birmingham,
April 7th, 1903.

MY DEAR DARWIN,

Let it be granted that I am an ass—this will prevent your being able to claim to have discovered it after reading the rest of the letter. I have been looking out for more than a year for a neat mechanism to replace that hydraulic gear I use with my instruments, but I never really tried at it till last Sunday, and I was lucky enough to get a very simple device. I think it might work in with some of your things, the recorder, *e.g.*, so I will tell you about it, please regard it as a sort of exchange (a poor one I know) for your hints on the gas meter. The problem was:

Given one clock, and the power of making two electric contacts: to operate a shaft by the clock in either direction of rotation, to lock the clock when neither contact is made. Also the magnets worked by the contacts must not require too much current; the inertia of everything must be small so as to start and stop quickly.

I hope you may find the thing of use—I never knew a simple device which had all the advantages at once and consistently—before.

Yours very truly,
R. THRELFALL."

The sketch and notes were made by a man who was a mechanic, and were sent to one whom Threlfall knew would appreciate and approve of small but important points in design.

I think it will be agreed that the letter shows a delightful spirit of friendship between the two distinguished inventors.

ROBERT S. WHIPPLE.

45 Grosvenor Place, S.W.,
Aug. 18.

A Possible Connexion between the Troposphere and the Kennelly-Heaviside Layer

SEVERAL experimenters have noticed the existence of a correlation between alterations in the propagation of radio waves and the establishment of certain meteorological situations: but, until now, no definite result could be obtained. I have therefore investigated directly the relation of the Heaviside layer, on which the propagation of radio waves depends, to meteorological conditions.

From May 1931 until June 1932, I made, at short intervals, daily observations on the reflection height of waves of 100 metres in wave-length by means of a device invented by me some time ago.[1] The waves of 100 metres wave-length, as is well known, are generally reflected in the E region during daylight, and generally from some time just before or after sunset until sunrise their reflection takes place in the F region.

The time near sunset when the reflection is passing from the E region into the F region often presents remarkable variations from one day to another: the reflection from the E layer sometimes continues for a long time after sunset, until midnight even, for waves of 70-50 metres wave-length; at other times, after disappearing by sunset, reflection appears again a few hours after sunset itself. This is evidence of the existence of remarkable increases of ionic density in the E region, even after the action of ionising solar radiations has ceased. The examination of the data which were obtained from about 330 days' observations has led to the following conclusions:

The abnormal increases of ionic density in the E region are accompanied by particular isobaric situations, characterised by the presence of barometrical depressions at the place of observation or in the north of it. In anticyclonic conditions, or conditions with depressions in the south, the reflection of 100 m. waves from the E region ceases in the shortest time; from noon onwards ionic density gets rapidly smaller. In 330 days' observations I found only some ten exceptions to the above general rules.

The existence of a connexion between the troposphere and the first ionised layer (E) is therefore clearly suggested; its nature will be the subject of future investigations.

IVO RANZI.
Institute of Physics,
University of Camerino, Italy,
July 25.

[1] *Nuovo Cimento*, 8, No. 6, p. 258, July 1931.

An Optically Active Inorganic Salt

IN 1914. Werner[1] described the resolution into optically active forms of dodecammine-hexol-tetracobaltic hexabromide, $[Co[(HO)_2Co(NH_3)_4]_3]Br_6$. This has remained until recently the only example of an inorganic (that is, carbon-free) salt the molecular dissymmetry of which has been proved by optical resolution. A second optically active inorganic salt, which, although also of the 'complex' type, is of much simpler composition than Werner's salt, has now been obtained.

Sulphamide, $H_2NSO_2NH_2$, has long been known to act as a weak dibasic acid. When certain rhodium salts are treated with sulphamide dissolved in sodium carbonate solution, co-ordination occurs with the formation of sodium di-aquo-rhodium-disulphamide, $Na[(H_2O)_2Rh(HNSO_2NH)_2]$, a compound of the 'diammino-tetracido' type in which each sulphamide residue occupies two co-ordinate positions. This salt should be capable of existence in two isomeric forms, one having the two water molecules in the 1 : 2 or *cis* positions in the six-co-ordination octahedron, and the other having these molecules in the 1 : 6 or *trans* positions. The first isomeride is dissymmetric, and should be resolvable into optically active forms, whilst the second possesses a plane of symmetry and should be non-resolvable.

When an aqueous solution of this sodium salt was treated with *dextro*-nor-ψ-ephedrine sulphate, the alkaloid salt of the complex anion was slowly precipitated; the first fraction thus obtained, on treatment with sodium hydroxide, gave a *lævo*-rotatory sodium salt having, for the mercury yellow line, $[\alpha] = -9 \cdot 6°$ and $[M] = -34°$. Treatment of the racemic sodium salt similarly with *dextro*-phenyl-ethylamine hydrochloride gave the amine salt, which in turn furnished a dextro-rotatory sodium salt having $[\alpha] = +8 \cdot 9°$ and $[M] = +31°$. Although it is not claimed that these represent the optically pure enantiomorphs, the resolution proves the presence of the 1 : 2 or *cis* isomeride in the sodium diaquo-rhodium-disulphamide.

Platinum compounds of similar composition have also been prepared, and their resolution is now being investigated.

F. G. MANN.
The University Chemical Laboratory,
Cambridge, Aug. 22.

[1] *Ber.*, 47, 3087; 1914.

Dimensions of Fundamental Units

THE recent world-wide discussions upon the electrical and magnetic units and their dimensions have focused attention once more upon the discrepancies which occur in the various textbooks. It has always seemed to me that there was no justification for regarding the three magnitudes, mass, length, and time, as necessarily fundamental, and a system in which quantities expressed in those dimensions have fractional indices is unsatisfactory. If we take the course of regarding quantity of electricity as a fundamental, and introduce Q for its dimension, we get the following table:

Quantity.	Dimension.
Quantity	Q.
Current	$Q.T^{-1}$.
Magnetising force	$Q.T^{-1}.L^{-1}$.
Magnetomotive force	$Q.T^{-1}$.
Magnetic Flux	$M.L^2.Q^{-1}.T^{-1}$.
Flux density	$M.Q^{-1}.T^{-1}$.
Permeability (μ)	$M.L.Q^{-2}$.
E.M.F.	$M.L^2.Q^{-1}.T^{-2}$.
Resistance	$M.L^2.Q^{-2}.T^{-1}$.
Sp. Ind. Capacity	$Q^2.T^2.M^{-1}.L^{-3}$.
Pole strength	$M.L^2.Q^{-1}.T^{-1}$.

It will be noticed that the introduction of a new dimension has automatically wiped out all fractional indices; but this is not all. Examination of the dimensions shows that wherever Q appears in the numerator, M appears in the denominator and vice versa. Consequently, if M be regarded as a function of Q, the former would disappear entirely from the table, and everything in mechanics, as well as in electricity and magnetism, could be put in terms of Q, L, and T.

Further, on the assumption that magnetism is due to spinning electrons, we obtain for μ the expression $\mu = \tau eh/4\pi m$, where τ is a pure number. Here again, then, on the above assumption, Q and M will cancel.

It seems to me that these simplifications are too striking to be merely a matter of coincidence.

WILLIAM CRAMP.
The University,
Edgbaston, Birmingham,
Aug. 9.

Research Items

The Towednack Gold Hoard.—The affinities and dating of the hoard of gold objects found at Towednack, Cornwall, in December 1931 and May 1932 (see NATURE for Jan. 16, 1932, p. 90) are discussed in *Man* for August by Mr. Christopher Hawkes. Nine pieces were found, of which four are finished ornaments, two torcs, and a pair of bracelets. Two bracelets are unfinished and the remaining three pieces are bent rods or bars, evidently a goldsmith's raw material. No. 1 is a large torc, 45 inches in length, with enlarged terminals, circular in section, tapering inwards. The main portion is triangular in section and twisted from right to left. The whole is coiled double, and the terminals twisted for interlocking. No. 2 is a triple torc of a pattern hitherto unknown in prehistoric gold work, the body of the torc being formed of three strands of gold wire, each of triangular section and twisted like No. 1. The strands are welded together at the ends to form the terminals, which are bent back to interlock. It measures 4-4½ inches across. Nos. 3 and 4 are a pair of bracelets, quite plain, formed of rods circular in section, bent in an oval penannular form. They are excellently finished, smoothed, and polished. Nos. 5 and 6 are obviously unfinished, awaiting smoothing and polishing, but clearly intended to be quite plain like the previous pair. Of the rods, one is lozenge-shaped in section, the others irregular. There is no reason to think the gold is not of Wicklow origin. The two torcs obviously provide the firmest basis for chronology, and although the second is without parallel, its complexity of structure and fineness of workmanship point to an advanced stage in the development of torc manufacture. The simpler workmanship of No. 1 invites an abundance of comparative material, and an examination in detail of torc types suggests that it is a developed type, but earlier than the fully established Late Bronze Age types, for example, the Morvah hoard, and preceding the full establishment of the Late Bronze Age culture in Cornwall and Ireland. It belongs, then, to the period 1000–750 B.C., a period of transition, perhaps marking a renewal in the Irish-Cornish gold and tin trade.

Menominee Indian Music.—In a report on an investigation of the music and song of the Menominee Indians of Wisconsin (*Bull.* 102, Bureau of American Ethnology), Miss Frances Densmore records a close resemblance in ceremony and custom, as well as in the songs accompanying them, to the Chippewa. The medicine lodge of the Menominee is practically identical with the Grand Medicine Society of the Chippewa; and in the drum ceremony, which originated with the Sioux and is thought to contain elements of Christianity, the observances of the Menominee are closely akin to those of the Chippewa. On the other hand, in the use of war-bundles and hunting-bundles and in the morning star legend, they resemble the Winnebago. The songs recorded are mostly of a ritual character; but there are also love songs and lullabies. Some of the songs are those used in connexion with the ritual games, the bowl-and-disc game, the double-ball game, and lacrosse, which are played ceremonially for the benefit of a person who has dreamed a dream. The ceremonial character of the game is indicated by the fact that it is immaterial which side wins. Songs sung in connexion with adoption dances are recorded, as well as a number connected with treatment of the sick. Underwater and underground powers are frequently mentioned in connexion with the songs. Chief among the latter is the 'underground bear', a white bear larger than a grizzly, said to be an ancestor of the Menominee tribe. It emerged from the ground as an Indian near the present site of Marinette, Wis., and was followed by more Indians. The chief of the 'underwater' powers is the 'underwater snake', usually referred to as the 'hairy snake', which lives in the water and personifies the powers of evil. If the body of anyone who has been drowned is found in an upright position, it is believed that he has been drawn down to his death by the underwater snake.

The Arthrodira.—Of recent years there has been a considerable accession to our knowledge of the Arthrodira. This group of Devonian fish-like animals has had a chequered career in regard to its zoological position. At first regarded as water beetles, these animals next became reptiles, and at length were recognised as fishes of some kind. Recently, Stensiö in an important paper on the head of *Macropetalichthys*, in which a very detailed account of the elasmobranch-like brain structure is given, came to the conclusion that the Arthrodira as a whole were true fishes and represented an early offshoot of the elasmobranch line. The most recent pronouncement on the subject is by Heintz (Anatol Heintz, "The Bashford Dean Memorial Volume", Article 4, 115-224. American Museum of Natural History, 1932). This investigator not only denies the elasmobranch relationship of the Arthrodira, but, while agreeing that *Macropetalichthys* is elasmobranch in affinity, also disputes its connexion with the Arthrodira. If this be the case, then the evidence of the elasmobranch affinity of the Arthrodira, based as it is chiefly on the structure of *Macropetalichthys*, falls to the ground. Heintz returns to an older view that the Arthrodira (together with the Antiarchi) form a separate group unconnected with any other group of fishes, and one which is perhaps not to be considered as formed of true fishes at all. They are ranked therefore as a class equivalent to the classes Agnatha (Cyclostomata) and the Pisces, and the name Placodermata, given by McCoy in 1840, is restored. The chief character on which this view is based appears to be the structure of the jaws, which is *sui generis* and unknown in any other form of animal.

High-Moor Vegetation of Eastern Prussia.—Dr. Reimers and Dr. Hueck have recently given an account of the high-moor vegetation of eastern Prussia (*Abhand. d. Math-naturw. Abt. d. Bayer Akad. d. Wiss.* Suppl.—Band 10 Abh. Munchen 1929, pp. 407-494, 12 plates, 2 maps, and 14 text figures). This is of an extensive rather than intensive character, based on the examination of a number of examples for which species lists are furnished and relative frequencies given. Most of the moorland communities described appear to conform in general terms with the zonal communities presented in the moorland of Ezeretis. Here open water occupied by *Nymphæa* and *Nuphar* is succeeded by a community in which the dominants are *Carex limosa–Scheuzeria palustris* and *Oxycoccus vulgaris*. The last-named is also common in the next zone dominated by *Rhynchospora alba*. A drier community is characterised by *Andromeda polifolia–Drosera anglica* and *Sphagnum rubellum* (in contrast to *S. cuspidatum* in the preceding zones). The driest area is occupied by *Calluna* heath, which in its damper parts is associated with *Ledum palustre* and *Rubus chamæmorus*, whilst in its drier parts colonisation by *Pinus sylvestris* may take place. Low moor vegetation also occurs locally with *Menyanthes trifoliata, Ranunculus lingua, Peucedanum palustre, Comarum palustre, Aspidium thelypteris*, etc. A number of transition types are described; also several woodland communities, the status of which is not quite clear.

Inheritance of Resistance to Wilt Disease in Cotton.—An investigation of the resistance of Egyptian cotton to the wilt disease (*Fusarium vasinfectum*), and its inheritance, has been made by Dr. Towfik Fahmy (*Bull.* No. 95, Ministry of Agriculture, Egypt). He classifies plants as susceptible, resistant, or immune according to whether they die as seedlings in infected soil, recover after developing mottled leaves, or show no symptoms. Some Egyptian varieties are completely susceptible, while others show a percentage of resistance and immunity. In crosses, immunity is dominant to susceptibility. The F_2 in one cross (Giza 7 × Sakha 3) gave 75 per cent immune, 15 per cent resistant, and 10 per cent susceptible. The immunes may segregate or breed true. The resistant plants in F_3 may give all three types or only immune and resistant. In a cross between susceptible and immune, there is an increase in the resistance of susceptible plants, as measured by the incubation period before the symptoms of the disease appear. Also, mother plants with a long incubation period have a higher percentage of immune progeny than those with a shorter incubation period, which are therefore less resistant. The correlation between susceptibility and length of fibre has also been studied.

Slime Moulds in Soil.—"The Distribution of Dictyostelium and other Slime Moulds in Soil" (K. B. Raper and Chas. Thom. *J. Wash. Acad. Sci.*, **5**, 22, No. 4, pp. 92-96, 1932) describes the occurrence in soil of various members of the Acrasieæ, a group of fungi closely related to the Myxomycetes, but which reproduce by means of amœbæ and have no flagellate stage. The organisms described belong to the genera *Dictyostelium* and *Polysphondylium*, and have hitherto been regarded as manure-inhabiting fungi. The present report shows that they are a normal part of the soil micro-flora, and clears up one of the puzzles as to the identity of the amœboid forms found in soil. The use of suitable culture methods will probably show that many of the so-called amœbæ in soil are only stages in the life-histories of such fungi.

Geology of Uganda.—The Annual Report of the Geological Survey Department of Uganda for 1931 (Entebbe, 1932, pp. 20) records many features of geological interest. Mr. W. C. Simmons has discovered a true unconformable sedimentary junction between the Karagwe-Ankolean beds and the underlying basement complex. Dr. A. W. Groves has proved the existence in Uganda of a charnockite series closely paralleling that of India. As in India, some of the occurrences are associated with magmatic iron ores and graphitic schists. The chromium-bearing mica, fuchsite, has also been found in the charnockite areas. Dr. Groves records the effects of shearing movements on the crystalline rocks on both sides of Lake Albert. He finds that the degree of brecciation, granulitisation, and mylonitisation is related to the distance of each specimen from the nearest rift scarp, and reaches the conclusion that the disturbances bringing about the formation of the Albertine rift valley were responsible for these shearing effects. The observations thus support the compression hypothesis of rift-valley formation. They also imply the removal of a considerable overburden by denudation, corresponding to the accumulation of thick deposits in the Albertine depression. The tectonic activity which gave rise to the rift, and is probably still in progress, must therefore have begun long ago. It is announced that Mr. Combe has completed his memoir on the tinfields of Ankole. The finding of cobalt and nickel-copper ores on Ruwenzori is also recorded.

Distribution of Earthquake-Centres in the Philippines.—Father W. G. Repetti, *S.J.*, who recently studied the distribution of Philippine earthquake-centres north of Manila during the years 1920–29 (see NATURE, **129**, p. 367; 1932), has continued his work on those lying to the south of the capital. During the same ten years, there were in this region 102 earthquakes, the epicentres of which could be determined with accuracy by means of seismographic records. With one exception, all these epicentres were submarine. The most important zone is the ocean trough known as the Philippine Deep lying off the east coast of Mindanao. Epicentres are concentrated in two principal areas, one in lat. 6° 30′ N., long. 126° 40′ E., the other in about lat. 7° 45′ N., long. 127° 10′ E., both lying between 25 and 30 miles east of Mindanao.

Gas Burner Design.—The Bureau of Standards at Washington, in co-operation with the American Gas Association, has been engaged for some time determining the conditions which limit the efficient operation of gas burners of various types using gases of many different compositions, and the results so far obtained are embodied in a paper by Messrs. J. H. Eiseman, E. R. Weaver, and F. A. Smith in the June issue of the *Journal of Research*. In it the conditions which were indicated qualitatively in Circular No. 394 of the Bureau are specified quantitatively for a domestic burner of the 8-prong star type with 44 jets. For each rate of supply of gas measured in British thermal units per hour per jet, the percentage of the total air necessary for complete combustion which must be mixed with the gas before it arrives at the jet, and which on one hand will prevent a yellow tip and on the other neither produce a flash back nor a blow out, is shown by curves for jets of various diameters. The influences of the height above the jets of the utensil to be heated on the production of carbon monoxide and on the efficiency of the burner are also shown.

Crystalline Structures in Glasses.—Lord Rayleigh has published a set of photographs of various glasses, taken between polarising nicols, which show the presence of particles and threads, in size very approximately of the order of a millimetre, having crystalline structure not due to mechanical strain (*Proc. Roy. Soc.*, July). These had been previously found in fused quartz and a phosphate glass known as Corex, and were likened to the Lehmann structure in liquid crystals. They are not present in silica glasses which have not a large silica content, the limiting quantity being about 80 per cent, as in Pyrex. Silica is also not essential for their production, as they may appear in phosphate and borate glasses. When present, they naturally make the material incompletely isotropic, and their complete removal presents an interesting, if not indeed an intractable problem. The effect is possibly connected with the devitrification of glasses and the crystal structure found in them by means of X-rays.

Protein Monolayers.—Investigations of proteins as monomolecular films on liquids, a method previously attempted with indifferent success, has now been developed satisfactorily by E. K. Rideal and A. H. Hughes (*Proc. Roy. Soc.*, July). In the earlier work, the films formed were probably not homogeneous; in the present work, homogeneous films of known weight have been made by depositing a fragment of the protein from the tip of a delicate quartz fibre microbalance. These films were then examined by compressing them on the surface in a Langmuir film apparatus, as well as electrically and optically. Gliadin, with which most of the work was done, gave homogeneous films with a thickness so low as 3 A., which changed on compression to a form having many of the properties of a gel, and quite possibly

the two-dimensional analogue of this state of aggregation. It is supposed that the basic polypeptide chains of the protein are stretched out flat on the surface in the most expanded state of the film, and that on compression and gelation the side chains to the main polypeptide chain are forced out of the surface.

The Heavy Hydrogen Isotope.—Of several recent papers on H^2, one by E. W. Washburn and H. C. Urey (*Proc. U.S. Nat. Acad. Sci.*, July) is of outstanding importance in indicating a possible electrochemical method for separating it in quantity. In electrolysis, there will probably always be some difference between the electrode properties of different isotopes of the same element. Generally, this will be small, but with hydrogen it is apparently significant, and in the electrolysis of water the residual liquor should perhaps contain a marked excess of the heavy isotope. A long experiment to test this is in progress at the United States Bureau of Standards, but meanwhile some commercial residues have been examined, and show the expected enrichment qualitatively. Other chemical reactions might produce a similar change in the relative amounts of H^2 and H^1, and the problem of their relative abundance in Nature is thus complicated by the history of the hydrogen-containing substances investigated. In the first July number of the *Physical Review*, the concentration of H^2 in 'ordinary' hydrogen is estimated to be about 1 in 30,000 by W. E. Bleakney, from mass-spectrum measurements, and the mass of H^2 is given as $2 \cdot 01353 \pm 0 \cdot 000064$ by K. T. Bainbridge; no evidence for the presence of helium isotopes could be found by the former.

Colour and Mineral Content of Honey.—Analyses of several specimens of American honey by Schuette and Remy (*J. Amer. Chem. Soc.*, July), in which special attention was given to the presence of manganese and copper, on which emphasis has been laid by students of nutrition, have given interesting results. The analyses of twenty-two specimens of honey, of which eighteen were taken directly from the comb, showed that the mineral content of the dark-coloured varieties was higher than that of the light-coloured. The manganese and copper contents were also higher in the darker-coloured honey. The average percentage of ash in the light honeys was 0·06, that in the dark honeys 0·17. The light honeys contained an average of 0·29 mgm. copper and 0·30 mgm. manganese, the corresponding values for the dark honeys being 0·56 mgm. and 4·09 mgm. The maximum figures were 0·70 mgm. copper and 0·44 mgm. manganese for light honeys, and 1·04 mgm. copper and 9·53 mgm. manganese for dark honeys. The characteristics and flavour of honey are probably influenced to a marked degree by nectar and pollen. They, in turn, may well vary in composition and quality according as the plant which produced them is affected by such growth factors as the meteorological conditions prevailing in its habitat and the nature and fertility of the soil. It is suggested that a dark honey should have a higher nutritive value than a light one, although colour and quality often bear an inverse relationship to each other in the lay mind.

Astronomical Topics

The Corona without an Eclipse.—*L'Astronomie* for June contains an article by M. B. Lyot, giving further particulars about his results obtained at the Pic du Midi. He states that the brightness of the inner corona is about equal to that of the planet Mars, which is readily visible in daylight; but observation of the corona is rendered more difficult by the great brightness of the sky near the sun; this is, however, greatly diminished at a height of 10,000 feet, especially when cloud and dust are absent; a further difficulty, due to diffused light in the telescope, is diminished by keeping the lenses quite free from dust, and by placing diaphragms in the tube, slightly larger than the solar image, to shut off sunlight. In order to distinguish instrumental defects from genuine solar markings, the coronagraph was rotated slightly between exposures; instrumental markings remain in the same place on the plate, but solar ones follow the solar image. Using a red screen, it was possible to view prominences directly, without a spectroscope; a Wratten screen, transmitting light between wave-lengths 6500 and 6600, permitted photographs to be taken of coronal jets, rising to a height of 7′ above the sun's limb.

M. Lyot gives measures of the wave-lengths of the green and red lines in the coronal spectrum; the plates were measured at Meudon by M. H. Grenat, who found for the green line 5302·83 on the east of the sun and 5302·87 on the west; the difference is in the right direction for rotation, but no stress is laid on this. The line in the red, which was traced to a height of 6′ above the limb, gave wave-length 6374·75, but with a probable error of 0·15. Unsuccessful attempts were made to photograph other lines at 4232, 4086, and 3986, which had been obtained from eclipse photographs.

M. Lyot notes, in conclusion, that sunspot activity was decidedly low when these results were obtained; he hopes for better results near maximum. He makes the observation that much longer exposures can be given than during eclipse.

Sunspots and Comet Activity.—De Morgan in his "Budget of Paradoxes" describes as a joke a correspondence between Pons and von Zach, in which the latter humorously explained Pons's failure to find comets during a certain period by noting that sunspots had also been absent then; Pons took this seriously and made a successful search for a comet after the return of large sunspots. De Morgan adds, "It would mend the story exceedingly if some day a real relation should be established between comets and solar Spots". Something like this suggestion has now actually come to pass. *Popular Astronomy* for May contains an abstract of a paper by Messrs. Hulbert and Maris, which brings forward many striking instances in which unusual solar activity has synchronised with remarkable phenomena in comets visible at the time. It is not the first time that the suggestion has been made. It was noted that the activity of Morehouse's comet in September 1908 came at a time of spot activity; the greatest magnetic storm of the year occurred on Sept. 11; many people thought then that the two events were connected. Indeed, since all cometary activity is now ascribed, directly or indirectly, to solar action, it is quite to be expected that the action of the sun on comets should depend on its state of activity.

Hulbert and Maris note that there were magnetic storms in the autumn of 1835, when Halley's comet exhibited striking changes, and again that a great storm occurred on Dec. 3, 1846, a few days before Biela's comet split in two. Of course, the solar activity does not bring comets, but it may well increase the brightness of those that happen to be there, and so increase the chance of discovery. It thus appears that the jest of von Zach may be taken in earnest.

The Solar Chromosphere *

THE spectrum of the solar chromosphere may be observed at a time of total eclipse by various methods. Frequently the thin crescent of the solar gases is photographed through a prismatic camera, the crescent itself acting as slit. In 1898, Dr. W. W. Campbell devised an important modification of this method of observing the flash spectrum. It consisted in the introduction of two new features, (1) a wide slit in the focal plane of the camera perpendicular to the dispersion and so to the monochromatic image-crescents, (2) a moving photographic plate moved during the exposure in its own plane in a direction perpendicular to the slit. The slit permits a short length (of the order of $\frac{1}{32}$-inch) of the central portion of each crescent to fall on the plate.

In the resulting photograph each bright line in the usual flash spectrum appears as a longer or shorter bright line, straight and normal to the dispersion, terminating at one end at a point corresponding to the instant at which the whole radiation from the still uncovered chromosphere is insufficient to affect the plate. In the other direction each bright line ultimately 'fades' into the corresponding Fraunhofer absorption line.

The intenser the radiation from the chromosphere for a given distribution of intensity with height, the longer the line outside the apparent limb-level; and similarly the less rapidly the intensity decreases with height, the longer the line. The apparent limb-level is well marked in the photographs, and it is possible to analyse the spectrum from the moving-plate spectrogram at any assigned 'height' on the plate, but it must be remembered that the 'intensity' at any given 'height' on the plate is a function not of the chromospheric radiation at that height but of the integrated chromospheric radiation for all levels above that height. Thus the spectrograms are not what they appear to be at first sight, and some mental effort is required to keep the true interpretation vividly in mind.

The method was successfully employed by Campbell at the eclipses of 1898, 1900, 1905, 1908. Though these results were described in brief immediately after each eclipse, full details waited until the present. We now have, in this splendid volume from the Lick Observatory, the complete analysis of the chromosphere results by the moving-plate method and a series of reproductions of the spectrograms. The work has been carried out by Dr. Donald H. Menzel, and he is to be congratulated on the service he has rendered to solar physics.

In the introduction, Dr. Campbell defends the moving-plate method against criticism, and points out its advantages as a *continuous* record of the changes in the flash spectrum as the chromosphere is gradually covered or uncovered by the moon. Approximately two-thirds of the volume is occupied by spectroscopic tables, computed by Menzel. These tables give possibly the most complete information on the flash-spectrum yet published. The whole of the measures are arranged twice over, once according to wave-length and then again arranged according to element, the full multiplet designation being given for each line, together with estimates of its 'intensity' at various 'heights' as measured by microphotometer tracings. The labour of compilation must have been immense, and the double tabulation will enormously smooth the paths for future workers.

Dr. Menzel reaches the surprising conclusion that the contours of all chromospheric lines at any given level are essentially the same curve, the vertical scale only being different; and further, that the contours are broader and more flattened at the higher levels. As Menzel says, this is the reverse of what would be expected. Insufficient information is given about the apparatus employed, etc., to form a judgment whether the effect is real or simply a photographic effect. The reproduction of a few microphotometer tracings would have been of interest.

The remaining one-third of the volume is a valuable digest of current theories of contours of spectral lines in stellar atmospheres, degrees of ionisation, etc., together with various applications to the results of the chromospheric observations. It is extremely useful to have a consistent treatment of the whole problem; and Dr. Menzel's analysis is in many places original. His final conclusion (stated with critical reservations) is that the chromosphere is probably in a state of turbulence in which radiation pressure plays a part. He criticises the attribution to the chromosphere of a static form of equilibrium under radiation pressure, but it may be noted that he ultimately shows (p. 286) that Minnaert's observed value of the residual central intensity in the ionised calcium lines is consistent with an almost 'fully-supported' chromosphere. Dr. Menzel's analysis is throughout directed towards an attempt to infer what is the actual state of the chromosphere as implied by observation; he is not in general concerned with the more fundamental problem of why the chromosphere comes to have its particular state. Some of the theories of chromospheric equilibrium which he views unfavourably owed their origin to an attempt to see in what ways it is possible for a stellar atmosphere to thin out into space, how radiation pressure rises into importance as collisions become rarer, and similar problems, rather than to impose a particular theoretical constitution on the solar layers. But Dr. Menzel's whole outlook is stimulating, and his volume will be a rich treasure-house, of both observation and theory, to all future workers on the subject.

E. A. M.

* Publications of the Lick Observatory, Vol. 17. Part 1: A Study of the Solar Chromosphere based upon the *Photographs of the Flash Spectrum* taken by Dr. William Wallace Campbell, Director of the Lick Observatory, at the Total Eclipses of the Sun in 1898, 1900, 1905 and 1908, by Donald H. Menzel. Pp. v + vi + 303 + 9 plates. (Berkeley, Calif.: University of California Press, 1931.)

Resuscitation in Asphyxia

THE recovery of persons in whom breathing has ceased following the inhalation of water or a noxious gas is attempted by artificial respiration, the method most generally adopted being the Schäfer prone pressure method. In certain cases, however, this method may not be suitable, or it may be inadequate to restore the normal respiratory movements. In collapse on the operating table under an anæsthetic, the cessation of breathing is sometimes quickly followed by stoppage of the heart: recovery may follow artificial respiration alone, or after cardiac massage or the injection of adrenaline into the heart in addition.

An experimental basis for the use of adrenaline is given by the results obtained in a recent investigation by Sir E. Sharpey-Schafer and W. A. Bain (*Proc. Roy. Soc. Edin.*, vol. 52, p. 139; 1932). Cats anæsthetised

with urethane were asphyxiated by occlusion of the trachea: the respirations became slower, and later deeper as well, and finally ceased: about a minute later a series of gasps occurred, which were usually ineffective in restoring the circulation (the trachea having been opened) unless the heart was also beating. The blood pressure fell when respiration ceased, and the heart gradually stopped.

Manual pressure on the chest may now cause recovery, both by renewing the air in the lungs and by pumping blood through the heart; artificial ventilation of the lungs alone may fail. The blood pressure may rapidly rise to an abnormal height before settling to the normal level, probably due to passage of adrenaline in the stagnant venous blood through the heart and arteries. The injection of adrenaline into the heart, especially the myocardium, will restore the beat to normal if the organ is beating feebly, or will arouse it again if given fairly soon after stoppage, together with inflation of the lungs. At the same time, it constricts the arteries and raises the blood pressure to its normal level or even higher. With restoration of the circulation, the breathing also returns, and though at first slow and deep, gradually becomes normal in character and rate. The injection of adrenaline into the heart, together with artificial respiration, will only be successful in the human being provided the breathing and circulation have not been too long in abeyance; ten minutes is probably the limit in ordinary circumstances.

The manual method of artificial respiration is inconvenient and difficult to apply successfully over a prolonged period of time; P. Drinker and L. A. Shaw have invented a mechanical respirator for use in the respiratory paralysis of anterior poliomyelitis in children and in cases of respiratory failure due to carbon monoxide poisoning, electrocution, drowning, etc. (*J. Franklin Inst.*, vol. 213, p. 355; 1932). The patient is placed, except for his head, in a closed chamber; the neck is encircled by an air-tight flexible rubber collar. Air is rhythmically pumped from the chamber, producing inhalation in the patient; exhalation occurs when the air pressure returns to normal. The patient's respiration is completely under the control of the machine when the negative pressure is 7 cm. of water. The apparatus has been found so successful that more than 150 are now in use in the United States and Canada. It is of interest to note that the optimum diameters of the rubber collar and head hole in the lid were obtained by plotting frequency curves from manufacturers' sales of different sizes of collars and hats.

Cosmic Radiation

IN a paper presented at the recent International Electrical Congress held at Paris, Prof. R. A. Millikan summarised in a convincing manner his views concerning the nature and origin of the penetrating cosmic radiation. The idea that they are neutrons, although it would combine the advantages of particles with failure to be deflected in the magnetic field of the earth, he considers unnecessary and not superior to the photon hypothesis. Commenting on the experiments which have been made to find if there is any preferential direction in which they enter the air, Prof. Millikan takes the view that there is no evidence that they are other than isotropic; this is in accord with his interpretation of their absorption curve, according to which the cosmic rays arise from processes involving the agglomeration of hydrogen nuclei for, probably, a very long time until they condense catastrophically to form a new nuclear type, which could scarcely occur where the temperature and pressure were not extremely low, as in interstellar space.

This paper contains some details of the experiments which have been made by Anderson in the Norman Bridge Laboratory in California, with a Wilson expansion chamber. The main aim of these was to deflect the products of the interaction of the rays with matter in a magnetic field, but many interesting subsidiary observations have been made.

The cosmic rays appear to be absorbed largely by nuclei, in general accord with the supposition that they arise in nuclear processes, but destroying the validity of the immediate application of the Klein-Nishina absorption formula, which assumes interaction with the extra-nuclear electrons. About thirty good trails have been photographed. Eleven show a proton with an energy of the order of some 10^8 electron-volts, two an electron of similar energy, three protons of between sixteen and forty million volts, five electron trails of about ten million volts, and the remainder particles of greater energy than 5×10^8 volts. The reality of the latter would not be in agreement with Prof. Millikan's atom-building postulates, the energy being excessive, but there is some doubt if they are authentic, as the trails show a number of sudden small deflections which are difficult to reconcile with the transit of such energetic particles. In seventeen per cent of the encounters with nuclei, the latter suffered disintegration.

International Conference on Radio Communication

RADIO engineers are looking forward anxiously to the international conference in Madrid on radio communication, which begins in September. In the *Wireless World* for Aug. 19 and 26, Noel Ashbridge, chief engineer to the British Broadcasting Company, states some of the problems of which a solution will have to be found. He confines himself to the broadcasting problem, and discusses first the problem of separating the frequencies and consequently the wave-lengths of the stations in Europe.

The existing agreement, known as the Prague plan, was put into operation by a large majority of the signatories in June 1929. It was decided that, so far as wave-lengths between 200 metres and 545 metres are concerned, the minimum separation between stations should be 9 kilocycles. This number was not selected on technical grounds but because it was the only hope of getting a general agreement. For the first year after the agreement the arrangement worked very well, only a few people who had signed the agreement failing to observe it in practice. During this year there were only a few stations which worked with a higher power than 15 kw.

Serious trouble started in November 1930, when Mühlacker, a high-power station, operated with a frequency adjoining that of London Regional. The result was immediate and severe jamming after dark on the London programme. The condition of affairs was very bad, because two years ago ordinary receivers were not nearly so selective as they are now.

The German engineers showed how the interference in the receiver could be cut out altogether, but the quality of the speech delivered was seriously affected. The solution adopted was to increase the separation between Mühlacker and London to 11 kilocycles. It is proved that if there is to be freedom from interference at the limit of the service area, the reproduction of frequencies of more than about 4000 cycles cannot be obtained and so the reproduction is not good.

It has been said that the response of a loud-speaker up to about 4000 cycles per second is sufficient for most practical purposes, and that, therefore, the interference problem does not now exist. Mr. Ashbridge states that, for really good quality reception, frequencies up to 7000 should be reproduced. A gramophone record reproduces something appreciable up to and a little beyond 5000 cycles, and yet the lack of the upper frequencies is quite noticeable to the critical ear. In future, this will doubtless be much improved. It would be a pity if broadcasting were permanently made inferior to the gramophone. Theoretically, the separation of broadcasting stations should be governed by the band of audio frequencies which it is necessary to cover in order to give full effect to the programmes.

If it is agreed to keep the 9 kilocycle separation, then those living in areas of high field-strength will get good quality service, whilst the others must have the higher frequencies cut off. If it were agreed to have a wider separation, then it would be necessary to reduce the number of stations in Europe as a whole. No one has ever pressed for a larger separation than 11 kilocycles, and experiments show that the range of reproduction can by this means be increased fifty per cent. The question of the limitation of the power of the various stations is a very difficult one. If they are too weak, we have 'fading'; if too strong, we cannot get the higher frequencies. It is difficult to say which is the more objectionable.

Calendar of Geographical Exploration

Sept. 7, 1298.—Marco Polo

According to Ramusio, Marco Polo was taken prisoner by the Genoese in a battle off Curzola in Dalmatia. Whether this was the exact date or not, it is at any rate certain that in 1298 Marco Polo was imprisoned in Genoa and that he there dictated his narrative to his fellow-prisoner, Rustician of Pisa. Marco Polo came of a family of Venetian traders; his father and uncle had visited the court of the Grand Khan, near Peking, on a journey which began in 1255. After their return, they again set out, taking Marco with them, in 1271. They travelled from Acre through Armenia, passed through Bagdad and Basra to Ormuz, turned inland and crossed Persia to Balkh. Thence they travelled across the Pamirs to Kashgar, went through Yarkand and Khotan to the south of Lob Nor, crossed the difficult Ordos desert and reached Peking. They remained in China for seventeen years, and returned by the sea route, a voyage which no European had ever before made from a Chinese port. Of all medieval travellers, Marco Polo is justly the most famous. To the unique opportunities given him by his long journeys and his prolonged stay in China he brought a vivid personality, keen and alert to notice everything of interest in his surroundings. In his narrative he shows a discriminating selection of the crucial facts of the geography and social and economic life of each of the many regions through which he passed. Thus, though six hundred years and more have passed since his book was written, it still holds readers by its charm and insight.

Sept. 7, 1787.—La Pérouse Strait

La Pérouse put in at Petropavlovsk in Kamchatka and thence sent Lesseps overland with the journals, notes, plans, and maps recording the work of his expedition. This foresight saved these most important observations from destruction, for after a letter of Feb. 7, 1788, from Australia, nothing more was heard of him until 1826, when Capt. Dillon found the wreckage of his ships on Vanikoro, an island to the north of the New Hebrides. La Pérouse sailed on Aug. 1, 1785, from Brest, to try to discover the north-west passage from the Pacific side. He reached Mount St. Elias, Alaska, on June 23, 1786, visited the Hawaii group, and discovered Necker Island. Thence he passed to the coasts of Japan, Korea, and 'Chinese Tartary', and discovered the strait between Sakhalin and the northern island of Japan which bears his name.

Sept. 7, 1837.—Adélie Land

The great French explorer, Dumont d'Urville, sailed from Toulon with two vessels, the *Astrolabe* and the *Zelée*, to search for land in the south polar regions. He attempted to follow Weddell's track, but was held up by pack ice and returned to make investigations in the Pacific. On Jan. 1, 1840, the vessels left Hobart, and discovered Adélie Land later in the month. D'Urville's work, both on this voyage and on a former one in 1826–29, added much to our knowledge of the geography of the Pacific, especially of the Fiji Islands, the Carolines, and the Moluccas. He also helped to chart more accurately the coasts of New Guinea and New Zealand. During his 1826–29 voyage he found evidence of the wreck of La Pérouse's vessel, which had disappeared in 1788, on the island of Vanikoro, one of the Santa Cruz group. On a voyage in the eastern Mediterranean he visited the island of Melos, and saw an old Greek statue which had just been unearthed. His keen appreciation of its beauty resulted in the acquisition by the Louvre of the famous Venus de Milo. This artistic sense led him to take the French artist Goupil with him to the antarctic; the resulting illustrations of his journal added much to its descriptive value, as well as to its beauty.

Societies and Academies

PARIS

Academy of Sciences, July 18 (vol. 195, pp. 193-292).—**L. Blaringhem**: Reappearance of fertility in a new variety of wild foxglove (*Digitalis purpurea*).—**Charles Achard, Augustin Boutaric, and Maurice Doladilhe**: The dilution of horse serum in electrolytic solutions. In an earlier paper it has been shown that by diluting 1 c.c. of serum to a volume l and measuring the optical density of the solution (h), then lh increases at first, passes through a maximum, and decreases to a limiting value. This work has now been extended to solutions containing salts.—**Emile Guyénot, W. Bartschi, and Mlle. K. Ponse**: The production of the yellow bodies studied by the method of transplantation of the ovary on to male guinea-pigs.—**J. Schauder**: The problem of Dirichlet generalised for non-linear equations of the elliptic type.—**J. Ottenheimer**: The displacement of water and the nature of the waves recorded in submarine explosions.—**D. Riabouchinsky**: Experimental researches on the formation of cavitations.—**Henri Mineur, Mlles. Renée Canavaggia and Marie-Louise Fribourg**: The correlation between the velocity of the star mass and their distance in the galactic plane.—**René Audubert**: The Debye-Hückel theory and electrophoresis.—**M. Pauthenier, Mme. M. Moreau-Hanot, and R. Guillien**: The charge of small

dielectric spheres in an ionised electric field.—**J.-J. Trillat** and **Th. v. Hirsch**: The diffraction of electrons by single crystals. The case of paraffin and the saturated fatty acids.—**Pierre Girard** and **P. Abadie**: The comparison of experiment and theory of dispersion in the Hertzian domain. The theory of Debye requires modification by the introduction of a factor representing the molecular constitution.—**Ch. Haenny**: The magnetic double refraction of salts of the rare earths in aqueous solution. Magnetic constants are given for twelve rare earths.—**Pierre Tarbès**: Method for the study of joining and expansion of glasses. Compensator for double refraction. If two glasses, possessing different coefficients of expansion are joined, the join may part at once, or possibly after several months. The method proposed measures the strains in the join by double refraction, using a special compensator.—**Léonard Sosnovski**: The polarisation of the fluorescence bands of cadmium vapour.—**Q. Majorana**: A new photoelectric phenomenon. Thin films of various metals deposited on glass (gold, silver, platinum, tin) show a variation in electrical conductivity on exposure to light. The effect was not observed with thin films of aluminium or zinc (see also NATURE, **130**, 241, Aug. 13, 1932).—**Mlle. Y. Cauchois**: A new method of X-ray analysis of crystalline powders utilising a monochromator with a curved crystal.—**Horia Hulubei**: The experimental study of the partial absorption of the X-rays. The author has attempted to repeat the experiments of B. B. Ray, but with negative results.—**Pierre Auger**: The emission of slow neutrons in the stimulated radioactivity of beryllium.—**Francis Perrin**: The constitution of the atomic nuclei and their spin.—**Mlle. M. Pernot**: The system mercuric bromide, potassium bromide, and water.—**Henri Muller**: The lowering of the eutectic point of ice–potassium nitrate, by acids, bases, and acid salts.—**Desmaroux** and **Mathieu**: Remarks on the structure of films of nitrocellulose with high nitrogen content.—**Charles Lapp**: The rotatory power of quinine in alcoholic solution. The specific rotatory power of quinine in alcoholic solution varies with the concentration. The facts are consistent with the hypothesis that the molecules of dissolved quinine form two groups, one in which each quinine molecule is associated with 40 alcohol molecules, the other group containing free quinine molecules.—**Lespieau** and **Guillemonat**: A new isomer of benzene, $CH_2 : CH . C : C . CH : CH_2$.—**Jacques Sordes**: The absorption in the ultra-violet of the hydrocarbons $(CH_3)_3C_6H_2(CH_2)_n . C_6H_2(CH_3)_3$.—**G. Hugel** and **M. Lerer**: The synthesis of alkyl aromatic hydrocarbons. The synthesis is based on the interaction of the hydrocarbon (napthalene, anthracene) with alkyl halide in liquid ammonia in the presence of sodium.—**R. Cornubert** and **G. Sarkis**: Contribution to the study of the extinction of the ketone function and the theories put forward to explain this phenomenon.—**Lucien Semichon** and **Michel Flanzy**: The application of chromic oxidation to some alcohols.—**Jacques de Lapparent**: The classification of the sedimentary clays.—**Henri Vincienne**: The flaky structure of the Ambérieu region (western edge of the southern Jura) and the age of the last Jurassic movements.—**Fernand Daguin**: A Cretaceous flora in the neighbourhood of Tissa (western Morocco).—**Maurice Hocquette** and **Mlle. Raymonde Villard**: The action of saturated ether vapour on the quiescent and dividing nuclei of the seedlings of *Raphanus sativus*.—**L. Plantefol**: The power of concentration of the cytoplasm. The formation of crystals by pollen grains, starting with neutral red.—**E. Miège**: The influence of various factors on the development of the inflorescence of cereals.—**B. Demetrović**: The effect of Mach's law. A discussion on the possibility of this effect being partly physiological and partly physical (diffraction).—**G. Tanret**: The hyperglycemic action of hordenine sulphate. Hordenine, in sufficient doses, possesses the hyperglycemic action of the true sympathomimetic substances (adrenaline, ephedrin).—**Marcel Avel**: The experimental analysis of the disappearance of the power of regenerating a head in the middle region of the body in *Lumbricus*.—**A. Macheboeuf**, **G. Sandor**, and **C. Nini**: Physico-chemical studies on the filtrates of acid-resisting bacilli of tuberculosis and of fleole.—**Mme. L. Gruzewska**: The α-lipase and amylase in the blood of some Crustacea.—**G. Champetier**: The fixing of water by cellulose. By a physico-chemical method, it is shown that cellulose fixes half a molecule of water per hexose group ($C_6H_{10}O_5$), whilst mercerised coaltar fixes double this amount.—**Maurice Piettre** and **André Guilbert**: The influence of electrolytes, especially sodium chloride, on the proteins of serum. The dispersion of myxo-protein in solutions of common salt cannot be explained by an adsorption of salt by the protein.—**Jacques Parrod**: The oxidation products of levulose in ammoniacal solution by methylene blue and atmospheric oxygen, at laboratory temperature. The products of this oxidation were 4-methoxy imidoazol, *d*-4-arabinotetroxybutylimidoazol, and a new substance imidoazol-4-formamide.—**Jean Cheymol** and **Alfred Quinquaud**: The exchanges of normal calcium in dogs deprived of their genital glands. Subsequent ablation of the parathyroids in the female dog results in the usual reduction of calcium in the serum.—**Joseph Lignières**: A new method of immunisation against diseases with filtrable viruses; its application to antiaphthous vaccination.

Cracow

Polish Academy of Science and Letters, May 2.—**K. Dziewoński** and **M. Brand**: The synthesis of ketones, acetyl derivatives of β-methylnaphthalene. By the interaction of acetyl chloride and β-methylnaphthalene in the presence of aluminium chloride, two isomeric ketones were obtained, which were identified. A diketone was also obtained.—**W. Friedberg**: The Miocene Pectinideæ of Poland and their stratigraphic value.—**Mme. N. Natanson-Grodzińska**: The plasticity of the instincts in the aquatic larvæ of Cataclysta.—**M. Konapacki** and **K. Ereciński**: The rôle of the vitelline sac in the metabolism of the embryos of *Syngnatus acus*.

Leningrad

Academy of Sciences (*C.R.*, No. 12, 1931).—**P. Schmidt**: A collection of flat-fishes from Fusan (Korea). The collection proved to contain twenty-four species, including one new to science, *Arnoglossus wakiayi*, sp. n. Fifteen of the species recorded belong to the Japanese fauna, six are more northern in their distribution, and only two can be considered tropical.—**G. Adlerberg**: The antelopes of northern Tibet and of neighbouring territories. A key is given to the Tibetan species of the genera *Pantholops*, *Gazella*, and *Procapra*, and notes on each species, with the discussion of geographical variation. *Gazella subgutturosa reginæ* subsp. n. is described from north-west Tsaidam.—**I. Starik** and **A. Gurevitch**: The adsorption of radium by glass. Description of experiments demonstrating that radium is adsorbed by glass in a neutral medium, while in an acid medium the adsorption is exceedingly small.

(*C.R.*, No. 13, 1931.)—**N. Filipjev**: Lepidopterological notes (11). Some forest pests from the Caucasian littoral of the Black Sea. Three species new to the Caucasian fauna are recorded, and one species new to science, *Platyptilia diversicilia*, is described.—**V. I. Gusev**: Bionomics of two species

of Microlepidoptera new to the U.S.S.R., *Evetria fessulatana* Stgr. and *Laspeyresia mariana* Zerny. The first of the two species develops in cones of *Cupressus*, the second in berries of *Juniperus*.—**B. Stegmann**: Origin of the bird fauna of the taiga. Pre-glacial fauna of the southern Siberian taiga was composed mainly of Sino-Himalayan elements, while that of the eastern Siberian taiga showed a very close relation with the fauna of North America.—**A. P. Semenov-Tjan-Shanskii** and **St. Breuning**: Three new species of the genus *Carabus* from Central Asia. Descriptions of *C. shokalskii* sp. n. and *C. znojkoi* sp. n. from Tjan-Shan, and of *C. redikortzevi* sp. n. from the Alexander range in Turkestan.—**V. V. Barovskii**: Notes on two species of beetles new to the fauna of the U.S.S.R., and description of a little-known species of the genus *Xylobanus* Ch. Waterh.—**S. Bernstein**: An example of a continuous function for which the Lagrange formula of trigonometric interpolation diverges.

(*C.R.*, No. 14, 1931.)—**A. Fersman**: The geochemical arcs of the Chibin Mountains.—**N. Filipjev**: Lepidopterological notes (12). A new *Hypochalcia* from the Ukraine. A description and figures of *Hypochalcia ukrainæ* sp. n.—**A. M. Popov**: *Anarrhichas orientalis* Pall., its systematic position and distribution, with notes on the species of *Anarrhichas* in the U.S.S.R.

SYDNEY

Royal Society of New South Wales, May 4.—**Edwin Cheel**: A review of systematology in botany (Presidential Address). In modern genetical literature, species and their subordinate units are regarded as populations. The units are not easy to define, and, because of this, certain biologists are of the opinion that the main criterion of an individual should be its physiological anatomy. Contrasts were given between the Jordanian methods of splitting the Linnean species into numerous elementary species or micro-species which appeared to be the same as what Lotsy termed 'group hybrids'. It has been found by extensive cultures that certain so-called 'pure lines' give a much higher percentage of mutation than others. From this result Nilsson draws the conclusion that the original 'pure line' did not contain only homozygotes, but also some sort of 'segregants' caused by the heterozygosity, thus upsetting the current theory of the production of pure, namely, homozygotic, lines by autogamous reproduction.

VIENNA

Academy of Sciences, April 28.—**Fritz Rieder** and **Elisabeth Rona**: Investigations on the ranges of the α-rays of actinium products. With RdAc the two prominent groups of lines with ranges of 4·7 and 4·35 cm., already seen by other workers, are observed. In addition, three other groups with lower intensities and with the ranges 4·6, 4·3, and 4·2 are found. These groups correspond with those recently detected by Curie and Rosenblum in the magnetic spectrum, but the α_1, α_2, and α_3 groups of these authors are not revealed by the author's procedure. The groups with ranges 4·3 and 4·2 were attributed by Curie and Rosenblum to AcX, but the results now obtained indicate with certainty that they belong to RdAc. Experiments with AcX preparations free from RdAc give the known group of range 4·3 cm., and also a second of range 4·1 cm. For AcC the groups with ranges 5·0 and 5·4 cm., observed by Rutherford, Wynn-Williams, and Lewis, are confirmed. With AcA, indications of a fine structure are obtained, since, in addition to the group of 6·47 cm. range, two weak groups with ranges of 6·35 and 6·60 cm. appear to be present. Moreover, with An a group with the range 5·6 cm. occurs, besides that with range 5·70 cm.

Forthcoming Events

Congress

AUG. 31–SEPT. 7

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (YORK MEETING)—continued.

Monday, Sept. 5.

At 10 A.M.—Prof. P. G. H. Boswell: "The Contacts of Geology: the Ice Age and Early Man in Britain" (Presidential Address to Section C).

Prof. Beatrice Edgell: "Current Constructive Theories in Psychology" (Presidential Address to Section J).

Prof. J. H. Priestley: "The Growing Tree" (Presidential Address to Section K).

At 5.30 P.M.—Mr. H. E. Wimperis: "Speed in Flight" (Public Lecture in the Co-operative Hall).

At 8 P.M.—Sir Richard Gregory, Sir Harold B. Hartley, Mr. Donald Gray, Dr. W. W. Vaughan, Prof. W. W. Watts, Mr. W. M. Heller: Discussion on "The Place of Science in the Education of Boys and Girls up to Sixteen Years of Age".

Tuesday, Sept. 6.

At 8 P.M.—Mr. C. C. Paterson: "Uses of the Photo-electric Cell" (Evening Discourse in the Co-operative Hall).

Official Publications Received

BRITISH

How Electricity helps the Farmer: with Special Reference to Power and Lighting in and around Farm Buildings; Dairy Farming; Poultry House Lighting. A paper presented by F. E. Rowland at the E.D.A. Farmers' Electrical Conference held at the Royal Agricultural Show, Southampton, July 7th, 1932. Pp. 19. Electricity and the Farm. Pp. 12. (London: British Electrical Development Association, Inc.)

City of Leicester Museum and Art Gallery. Twenty-eighth Report to the City Council, 1st April 1931 to 31st March 1932. Pp. 27. (Leicester.)

Technical College, Bradford. Diploma and Special Day Courses, Session 1932–33. Pp. 240+19 plates. (Bradford.)

Journal of the Royal Microscopical Society. Series 3, Vol. 52, Part 2, June. Pp. xvi+113-252. (London.) 10s. net.

Transactions of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne. New Series, Vol. 8. Pp. viii+165. (Newcastle-upon-Tyne.) 8s.

Navy: Hydrographer's Report. Report on Admiralty Surveys for the Year 1931, by the Hydrographer of the Navy. Pp. v-x. (London: Admiralty.)

(University of London): County Councils of Kent and Surrey. The Journal of the South-Eastern Agricultural College, Wye, Kent. No. 30. Edited for the College by Dr. S. Graham Brade-Birks. Pp. 274. (Wye.) 7s.; to Residents in Kent and Surrey, 4s.

Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 22: The Inhibition of Chemical Reactions. Part 5: The Influence of Pyridine and other Substances on the Absorption of Ethylene by Sulphuric Acid, and on the Surface Tension of Sulphuric Acid. By William Sydney Eagar Hickson and Dr. Kenneth Claude Bailey. Pp. 267-279. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

FOREIGN

Japanese Journal of Astronomy and Geophysics. Transactions and Abstracts, Vol. 9, No. 3. Pp. iii+127-243+13-82. (Tokyo: National Research Council of Japan.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 15, No. 3, May. Pp. 128-201. (Tokyo and Kyoto: Maruzen Co., Ltd.) 1.70 yen.

Annotationes Zoologicae Japonenses. Vol. 13, No. 4, May 5. Pp. 273-439. (Tokyo: Zoological Society of Japan.) 4.00 yen.

Handelingen van het Zesde Nederlandsch-Indisch Natuurwetenschappelijk Congres gehouden te Bandoeng 22, 23, 24, 25, 26 September 1931. Pp. 717. (Bandoeng: A. C. Nix and Co.)

Smithsonian Miscellaneous Collections. Vol. 87, No. 7: Preliminary Classification of Prehistoric Southwestern Basketry. By Gene Weltfish. (Publication 3169.) Pp. 47. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 81, Art. 6: A Newly Discovered West Indian Mollusk Faunula. By Paul Bartsch. (No. 2929.) Pp. 12+8 plates. Vol. 81, Art. 9: New Diptera, or Two-winged Flies from America, Asia and Java, with Additional Notes. By J. M. Aldrich. (No. 2932.) Pp. 28+1 plate. Vol. 81, Art. 11: The Forms of the Common Old World Swallowtail Butterfly (*Papilio machaon*) in North America, with Descriptions of Two new Subspecies. By Austin H. Clark. (No. 2934.) Pp. 15+8 plates. (Washington, D.C.: Government Printing Office.)

Egyptian University: Faculty of Medicine. Publication No. 3: The Third Pandemic of Plague in Egypt; Historical, Statistical and Epidemiological Remarks on the first Thirty-two Years of its Prevalence. By Prof. A. W. Wakil. Pp. vi+169. (Cairo.)

Transactions of the Academy of Science of St. Louis. Vol. 27: The Prairie Horned Lark. By Gayle B. Pickwell. Pp. iv+160+34 plates. (St. Louis.) 2 dollars.

SATURDAY, SEPTEMBER 10, 1932

CONTENTS

Editorial and Publishing Offices:
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Problems in the Advancement of Archæology

IT is some time since anyone so closely identified with field archæology as Dr. Randall-MacIver has presided over 'Anthropology' at an annual meeting of the British Association for the Advancement of Science. It was, therefore, not without wisdom that Dr. Randall-MacIver elected to make in his presidential address a comprehensive survey of the practical problems and relations of archæological science as it stands to-day, rather than to deal with the results of recent research or of some specific investigation. Yet more than the mere passing of time called for some pronouncement on general principles in matters which have seemed to him to require comment. In the last decade archæological method and technique have developed rapidly; while the range of archæological activity has been extended enormously in many directions both in time and space. Areas which were once regarded as widely separated and studied in isolation, are now often viewed as links in a single chain. No longer can the methods and aims of archæological investigation in any country be regarded as of little concern to those who stand outside the national boundary. The field of archæological studies, in fact, has undergone, and is still undergoing, a process of unification which gives a peculiar significance to any pronouncement on the organisation and administration of research which is put forward with the authority of a presidential chair of a section of the British Association.

Dr. Randall-MacIver admitted that to some extent he had been influenced in his choice of subject by the example of his predecessor in the chair. Prof. Radcliffe-Brown last year, it will be remembered, reviewed the methods of field work in ethnography and its relation to the problems in synthesis of the comparative worker. The two branches of investigation in the field have this in common, that they now make heavier demands than ever before on the technical equipment of the investigator. The development of both ethnography and archæology owe much to the amateur; but in neither does investigation stand any longer at the stage at which the field notes or the rough spadework of the passing traveller are likely to make any contribution of lasting value to the respective branch of science in which he is interested. At best they may point the way to the skilled and trained investigator. This is not a question of amateur *versus* professional—it is to be hoped that research in Great Britain, which owes so much to

the amateur, will never be debarred to him—but of the trained man, amateur or professional, against the untrained.

In laying it down as a principle which should be universally recognised, that none but a properly accredited and trained archæologist, approved and supported by a group or committee of experts, should be permitted to excavate any site whatsoever, Dr. Randall-MacIver opens up a whole nexus of problems that confront modern archæology and its future development.

The more recent legislation for the protection of ancient monuments in Great Britain admittedly represents a great advance, and has gone some way towards ensuring the skilled excavation of valuable sites. On the other hand, the British Parliament is still sufficiently individualistic in its way of thinking to admit private rights of ownership which are not always in the best interests of the community in the long run, especially when they endanger evidence which might be invaluable to the future archæologist and historian.

Dr. Randall-MacIver's suggestion that part of a site upon which excavations are being made, or are in contemplation, should be set aside for future investigation, after some more or less lengthy period has elapsed, in the light of more fully developed knowledge—a suggestion, by the way, which was made by Sir Flinders Petrie some years ago—is a counsel of perfection which perhaps few investigators would have the strength of mind to follow without the restraint of superior authority behind them. That all, however, are not without some measure of self-denial in the face of posterity is indicated by the recent example of Mr. Alexander Keiller, at Windmill Hill, who, as recently announced, has reserved part of his valuable Early Bronze Age site for a future generation.

The practice of different countries in relation to their ancient monuments is far from uniform. Nor can it be said that vigilance is exercised everywhere in an equal degree in securing the observance of regulations. In some cases legislation, excellent in intention, fails in its object through laxity in translating its provisions into action. France, for example, would appear a case in point, at least until recently, according to the statement of French archæologists themselves. In this connexion, and in addressing a warning of the dangers ahead to those countries in which archæological investigation has scarcely attained the stage even of infancy, Dr. Randall-MacIver has two interesting suggestions to offer. One, an international question, is the formation of something in the nature of an archæological Court of Appeal—a scientific League of Nations; and the other, a concern of each country individually, but of enormous moment to archæological science at large, deals with control of the sale of antiquities—one of the strongest incentives to the private owner's destructive activities. Both classes of problem are difficult enough, though on paper it is perhaps the lesser which presents the greater difficulty in the tangle of conflicting interests impeding any straightforward solution.

It is not to the purpose here to enumerate or discuss the many problems of State regulation of archæological investigation on a nationalist basis. They are many and varied. That, in the interests of the advancement of archæological science, uniformity in dealing with them, according to the most advanced knowledge of the day, is urgently demanded, is a matter of common opinion in archæological circles. The suggestion of an archæological League of Nations, perhaps, may have reminded some of Dr. Randall-MacIver's audience of the relation of the League of Nations to matters other than political, and of the existence of a Committee for Intellectual Co-operation. On the other hand, a body less cumbrous to move and in closer touch with the actual situation in many, if not all, of its aspects, is the recently inaugurated International Congress of Prehistoric Sciences, which, although it will come into existence at intervals only, has provided, by the institution of research committees, a machinery for at least the initial stages of exploration of the problem.

The difficulty of dealing with the sale of 'curios' to the collector lies at the root of the greater number of the unauthorised or unskilful exploitations of the sites of antiquity. Were it possible to divert the stream of gold which pours into the pockets of the unscrupulous dealer, much of the destruction of valuable evidence which goes on, especially in the East, would cease automatically. On the other hand, the institution of official 'curio' shops for the sale of museum duplicates on the lines of that in Egypt, to which Dr. Randall-MacIver referred, to be effective would have to be a monopoly, and while it certainly would add materially to the revenue of the museums, which are never—at least, on the basis of their own calculations—liberally financed, would open the way to a number of abuses which it would be difficult to check. In Great Britain, the more liberal law of treasure trove, a genuine, if restricted, interest in the origin and history of finds among the artisan and agricultural classes, and the system of the loan of duplicates by the museums, meet the more serious

difficulties which Dr. Randall-MacIver has in mind. It must be admitted, however, that only rarely in Great Britain do we find antiquities of sufficient intrinsic value or of such obvious interest as to tempt the unscrupulous. But Great Britain's support, if only through the wide geographical distribution of her archæological interests, would be a potent factor in securing action on a common basis in those countries in which the question is one of more vital concern. May we add that the creation of a conscience in the collector offers a field for missionary effort to the ardent archæologist.

Dr. Randall-MacIver is no respecter of persons in his criticism, and he does not hesitate to chide the museums which press their excavators for impressive specimens to add to their collections, without thought of the value of the insignificant (in the museum display sense) for the purposes of science. In this matter we should perhaps recognise extenuating circumstances for those museums which must depend for their existence on the generosity of subscribers.

In connexion with museum excavations, reference was made to what, from the archæologist's point of view, is an evil almost equally grave—the delay in publication of results, a fault to which not archæological institutions alone are prone. It is impossible to say how far delay in making available material for comparative study may have hampered advance in archæological studies. The example of Sir Flinders Petrie, who for many years has made it an invariable rule to publish his results within the shortest time possible after his return to England in each year, shows that this is no impossible ideal, in so far as nothing more than a record of facts observed is required of the excavator in the first instance. A time limit for initial publication might well be a condition of any permit to excavate.

Dr. Randall-MacIver's presidential address raises so many points of broad general, as well as specialist, interest, that the commentary might well outrun the text in length, and yet not be exhaustive. Nothing, for example, has been said of his views on the relation of archæology as a science to other branches of the study of man. Yet to the archæologist of the future this offers both a guide and a warning. Unless the study, one of well-defined and rigid limitations in method, be followed in the spirit which Dr. Randall-MacIver advocates, a spirit of liberal co-operation with other disciplines, it risks a specialisation as arid and as sterile as the antiquarianism it has superseded. Of this, however, with our present school of workers in the field, there is little danger.

The Biology of Snakes and Amphibia

(1) *The Biology of the Amphibia.* By Dr. G. Kingsley Noble. (McGraw-Hill Publications in the Zoölogical Sciences.) Pp. xiii + 577. (London: McGraw-Hill Publishing Co., Ltd., 1931.) 30*s*. net.

(2) *Snakes of the World.* By Dr. Raymond L. Ditmars. Pp. xi + 207 + 85 plates. (New York: The Macmillan Company, 1931.) 30*s*. net.

(1) IN recent years marked changes have taken place in the outlook of biologists. Zoology must inevitably rest upon a foundation of morphology and classification; yet it is being increasingly realised that the study of animals demands for its development more fertile ground than is presented by the facts of anatomy and phylogeny. The living animal is a side of zoology which dominates to-day. Dr. Kingsley Noble strikes a distinctively modern note in the work under notice in directing attention to the physiological aspect of the subject, and he has been successful in covering the dry bones of anatomy with living flesh.

Part I. (458 pages) gives a well-balanced picture of the structure, physiology, and ecology of the various groups of Amphibia, which are considered in relation to one another and to their environment. The opening chapters deal with general problems—amphibian ancestry, the mechanics of development, evolution, and adaptation. The reader will early realise that within the limits of the class the wide variety of modifications in larval and adult forms is remarkable: members of various families have taken independently to the land for breeding purposes, and we find unrelated forms adapted respectively for crawling, swimming, leaping, burrowing, climbing, parachuting—examples of convergence which have in the past done much to confuse systematists in their attempt to arrive at a natural classification. Yet, as Dr. Noble shows in a survey of life histories (Chap. iii.), larval modifications and nursing habits frequently serve as an important guide to the affinities of species: thus the closely related *Phyllobates* and *Dendrobates* (formerly placed in separate families) are the only genera in which the males are known to carry the tadpoles on their backs.

A series of chapters on the structure and function of the vascular, digestive, nervous, and other systems considers each in some detail. Here there is a good section on the endocrine glands, embodying the result of much recent research on the important rôle played by hormones in the physiology of development, and it is interesting to note the

practical value to zoologists of the gonad-stimulating pituitary secretion, which "provides a ready means of obtaining embryological material at any time of the year". The four chapters on amphibian behaviour and ecology, written in an easy style, are informative and stimulating.

Part II. (85 pages) deals with the classification of Amphibia. Here there is a clear discussion of the mutual relationships of genera, free from an overwhelming mass of systematic detail; students who wish to pursue further this aspect of the subject are referred to the concluding bibliography of comprehensive taxonomic works. We have noticed a number of misprints, "blut", "tadpones" (p. 132), "inhabiti monguntain" (p. 167), "grog" (p. 407); and in the full index there is no reference to the treatment of neoteny on p. 294. Extensive bibliographies (of which there are some 58 pages) add much to the usefulness of the book, and the well-produced text-figures, many of them new, attain a high standard of excellence. Dr. Noble is to be congratulated upon the remarkable range of fact and theory which he has assembled in these pages, and the publishers upon a valuable addition to their "Publications in the Zoölogical Sciences".

(2) Snakes have claimed the attention of man from earliest times. Yet few groups of animals are so little understood by the layman, and few have been more indiscriminately persecuted. This book will help to clear away the prejudice and unreasoning hatred so generally directed against these reptiles, the majority of which are harmless to man, and many of which (by the destruction of rodents) are of economic value. Dr. Ditmars, who as curator of reptiles in the New York Zoological Park has had unique opportunities of studying the habits of serpents, combines the knowledge of a trained herpetologist with the experience of a field naturalist. He writes of snakes with authority, and the descriptions of his pets, both as captives and in Nature, are lively, informative, and intimate.

Dr. Ditmars assumes in his readers no previous acquaintance with the group. The book opens with several introductory chapters on distribution, habits, and classification. There is an interesting account of "The Giant Serpents". It is perhaps comforting to learn from an authoritative source that, in spite of the numerous reports of larger specimens, the record *proved* measurement of *Python reticulatus*—the world's longest snake—does not exceed 33 feet. Chapters vii. and viii. deal with the harmless species of the New and Old Worlds, followed by an abbreviated account of the Opisthoglyph (rear-fanged) snakes.

The remaining, and main, portion of the book is devoted to the appearance, habits, and distribution of poisonous species. These chapters contain some useful information on the treatment of snake-bite and on the physiological effect of specific poisons. The zoogeographical arrangement here will be especially appropriate in the hands of sportsmen, field naturalists, agriculturists, explorers, and others to whom a knowledge of these creatures is a matter of great practical value. It is perhaps unfortunate that the American species receive more than their share of attention; thus the Old World harmless snakes (Colubrinæ) are condensed into less than half the space devoted to those of the New World, and no mention is made of the commonest tropical and South African genera, such as *Boodon*, *Chlorophis*, and *Philothamnus*.

The book is well got up, and 160 splendid photographic reproductions, mostly from living specimens, are valuable as an aid to identification, and will repay careful study. They testify to the author's skilful technique as a photographer, and the portrait of a King Cobra (Plate 38) has high pictorial merits. HUGH B. COTT.

A Physiologist looks at Wild Animals

Emigration, Migration, and Nomadism. By the late Walter Heape. Edited with a Preface by Dr. F. H. A. Marshall. Pp. xii + 369. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1931.) 12*s.* 6*d.* net.

DR. F. H. A. MARSHALL has edited and prefaced this posthumous work by the distinguished authority on the sexual cycle, Walter Heape. Few books cast a wider net for readers than this. The physiologist, the natural historian, the ecologist, the anthropologist, the psychologist, even the alienist, are concerned with the subjects treated. Yet how many of these, except the physiologist, will get past the first chapter? And how many physiologists will read the rest?

Many who would find the rest of the book of absorbing interest will be dismayed by this first chapter, for it includes many technical words which could have been avoided in a book of such wide appeal. Further, it is perhaps the most speculative part of the book, and was written before the author was acquainted with the work of Evans and others on vitamin E. The author foreshadowed the discovery of this vitamin. Recent research seems to show that he laid too great stress on nutrition as

a factor in the control of breeding seasons. It is true that certain of the higher animals do not breed in the absence of vitamin E, but evidence is not yet forthcoming that it is the absence of this factor in the non-breeding season which causes them not to reproduce.

There has been surprisingly little research on the actual cause of breeding seasons, presumably because the research must be physiological, and physiologists are mostly concerned with man and with animals which do not have breeding seasons in laboratories. Rowan and Bissonnette have, however, shown the importance of light as a controlling factor in the reproduction of birds, and other workers have obtained similar results with mammals. This recent research makes it probable that Heape has exaggerated the importance of the nutritional factor in the control of reproduction, despite the fact that in certain cases (as in sheep) food does play a part.

A wealth of natural history observations has been brought together in this book, bearing on the large-scale movements of animals. The author differentiates clearly between migration, which is a purposeful movement followed by a return, and emigration, which is the useless mass movement of the lemming and springbuck followed, not by return, but by death. The importance of territory in animal life is stressed. Eliot Howard's concept of the importance of territory in bird life is extended to almost the whole animal kingdom.

Heape saw clearly that if animals are machines, then they are vastly more complicated and unreliable and individual machines than most biologists are prepared to admit. The reader finds himself confronted with the problem of whether butterflies may be hysterical in certain circumstances, and animals are throughout regarded in a frankly anthropomorphic way. Heape does not hesitate to compare the movement of a pack of wolves with that of a nomadic tribe of men. Writing of birds, he says, ". . . it would seem to be clear that migration is not solely a matter of habit, or of instinct; reason may exert a part in it, and intelligence be accorded a more prominent place in the ordering of migratory movement than is generally acceded".

One cannot fail to be reminded of Elton's outlook, and to regret that Heape was not acquainted with his work. Especially is this so when the author is dealing with the periodicity of abundance in animals. Dr. Marshall has to some extent made good this defect, by giving brief accounts of Elton's work in footnotes. Heape thought that the regularly periodical emigrations of the lemming were due simply to overcrowding and scarcity of food. He overlooks the fact, pointed out by Elton, that animals may show the same periodicity on both sides of the Atlantic. Some unknown factor must evidently be at work. Otherwise, although widely separated animals might have a periodicity of approximately the same time-interval, they could not be expected to keep step in Canada and northern Europe.

The reader must be prepared for speculation if he is to enjoy the book. Even the most speculative will have qualms about a long description of the start of a butterfly emigration, which, as the author frankly admits, is only a phantasy. Many readers could advantageously skip large parts of the book, in which rather fragmentary information is given about a large number of species after a full and valuable discussion of a phenomenon of emigration, migration, or nomadism in the few forms on which much is known. The fragmentary parts might have been printed in small type, or placed in appendices, where they would no doubt have been valuable to a few, without taxing too heavily the skipping capacity of the majority.

The author's object in writing the book was to stimulate wider research on the comparative physiology of the reproductive system. If zoologists can be made to take an interest in function, or physiologists in wild animals, then his object will be achieved. JOHN R. BAKER.

Artificial Resins

Artificial Resins. By Prof. Johannes Scheiber and Dr. Kurt Sändig. Translated from the German by Dr. Ernest Fyleman. (The Specialists' Series.) Pp. vii + 447. (London: Sir Isaac Pitman and Sons, Ltd., 1931.) 30*s.* net.

AMBER for decorative purposes, shellac in the electrical industry and for gramophone records, copals for varnishes, rosins in soaps: all are natural resins. The importance of the part they play in the daily economy of the world is obvious; indeed, at least half a million tons of them are used annually. Latterly, they have been supplemented and even substituted at a rapidly increasing rate by substances made artificially by the systematic exploitation of numerous organic chemical reactions. Such products have many new economic potentialities, particularly since, with increasing experience, the control of the reactions which produce them becomes more accurate, so that the possibility is offered of varying their properties

widely and of increasing desirable qualities to a degree impossible with natural products. Already some forty thousand tons of synthetic resins are produced annually.

The book before us is a careful translation from the German, in which the authors' meanings have been reproduced as accurately as possible. Perhaps in consequence we find it somewhat involved in style and far from easy reading, even when allowance is made for the difficulties of the subject.

The first half is devoted to a general theoretical discussion of the various known forms of chemical polymerisation and condensation. The treatment will be found to be complete and of value to the now numerous workers in this field. The latter portion deals with the practical aspects of resin manufacture, discussing in turn the coumarone and aldehyde resins, the phenol-aldehyde resins, and the urea-formaldehyde condensation products. This section contains full references to the literature. Experts will find blemishes here and there, but they will readily pardon these in view of what is, after all, the main value of the book—its wealth of suggestive ideas.

The power of many organic substances, and of aldehydes in particular, to take part in chemical condensations has long been used in effecting chemical syntheses in the laboratory, where the aim has usually been to restrict the reaction to the formation of simple compounds and to avoid the production of resins. In the new industry, however, the formation of such resins is encouraged by working under conditions suitable to give products of complex and largely unknown constitution, but which under proper control are uniform from batch to batch. At first the practical operations were largely based on guesswork and experiment, but now the behaviour of the various types of unsaturated groupings is becoming understood, as is also the mutual influence of various radicals on them.

Looking ahead, there appears to be no boundary to what the synthetic resin industry may in time accomplish. Some enthusiasts even predict that our future furniture will be constructed from resins obtained by condensing formaldehyde, made from coke, with the phenolic constituents of low temperature tars, and that such material may largely replace wood in internal work. The wireless and gramophone industries are being largely built up on these resins. It is to be hoped, therefore, that the manufacture of all types of them will not be neglected in Great Britain. E. F. A.

The Enjoyment of Nature

The Open Air Year: an Anthology of the Seasons selected from The Times. Pp. xii + 242 + 20 plates. (London: *The Times* Publishing Co., Ltd., 1932.) 7*s*. 6*d*.

TO this volume of papers reprinted from the *Times*, Viscount Grey of Fallodon contributes a singularly happy introductory essay which in itself supplies unity or harmony to the book. There is probably little or nothing in the papers which is not already well known to specialists in the various subjects. There are, however, many things in this book about common country objects which, as Viscount Grey points out, are not common knowledge even to dwellers in the country, and perhaps still less to that increasing body of the public which is interested in outdoor Nature. In an attractive style and with a literary charm that is in no way inferior to that of such writers and observers as Richard Jefferies or W. H. Hudson, they convey a good deal of accurate scientific knowledge which should enable the visitor to any of the places or scenes described to discover and enjoy aspects of which he was previously unaware. The book is a worthy companion to Cornish's "Wild England of To-day" or Edmund Blunden's more recent sketches, "The Face of England".

In the true sense of the word, we have in this book popular science of a high order, and the reflection occurs in passing that the popular knowledge of physical as well as of outdoor Nature or natural science might well be encouraged by its exposition on similar lines. The writings of T. H. Huxley alone afford sufficient evidence that the accurate but lucid exposition of the more scientific aspects of biology is not too herculean a task for human powers. There are few more urgent needs at the present time than for first-class expositors in every branch of science who can link together as felicitously as in this book the accurate description or analysis of scientific observations or facts with a literary skill which has an intrinsic popular appeal.

In the introduction to which we have already referred, Viscount Grey, commenting on an observation in the essay "The Flame of Autumn", that the colours of autumn leaves cannot be robbed of romance by being harnessed to some utilitarian purpose, is moved to the reflection that the utilitarian purpose is secondary in the design of Nature, and to emphasise both the infinite beauty of the world and, separate from but inseparably connected with this, the power of man to perceive this beauty and to be moved by it. It is at least possible that our

present lack of the needed expositors in many branches of science is due to loss of this vision of beauty through the concentration on analytical or synthetic methods. It is only when we are able to perceive and respond to the beauty of our subject and to see it in some true perspective that we can expect to receive the power to expound to others, in language understood by all, the vision vouchsafed us, or the results obtained and the methods by which they were obtained. So far as outdoor Nature is concerned, volumes such as that under review, in kindling this vision and love of beauty, may also assist in the formation of a public opinion intelligent and strong enough to secure the action which in so many quarters is sadly needed, if serious depletion of the flora and fauna of our countryside is to be prevented and its beauty spots secured from irreparable damage in the local interests of some supposed utilitarian or business scheme.

Short Reviews

Biologie des Radiums und der radioaktiven Elemente. Von Prof. Dr. Julius Stoklasa. Unter Mitwirkung von Dr. Josef Pěnkava. Band 1: *Biologie des Radiums und Uraniums.* Pp. xiv + 958. (Berlin: Paul Parey, 1932.) 74 gold marks.

Several books have been written on the biological effects produced by the radiations from radioactive bodies, and they have presented the chief characteristic changes in living things in the relationship of such changes to the main issues of radiological treatment. It is fairly generally admitted now that although the main effect of the radiations is a direct one upon the tissues immediately irradiated, other effects are produced in an indirect way which may be of great importance in the final result of any radiological exposure. The aim of the authors in this exhaustive work (another volume is foreshadowed) is to present these biological effects from an entirely different point of view, and about two-thirds of the present volume is devoted to the description of elaborate methods of estimating the effects of the rays on vegetable life. It is only when p. 640 is reached that the animal kingdom receives attention, and even in this section the authors give their fullest consideration to the types of biological change that are most conspicuous in plant life, namely, those which regulate respiratory exchange.

Many of the experimental methods described in the dominant section of the book have been devised by one of the authors, and they leave the reader with little doubt of the profound effect which can be produced by radioactivity on young plants and seeds. The literature of a few years ago on this subject revealed acute differences of opinion among experimenters as to whether the radiations could stimulate cell life, and the authors have done a great service in getting together a comprehensive series of tests which serve to show how many factors involved in the processes of normal growth have to be taken into consideration before the term stimulation can safely be applied to any particular phase of the growing organism.

The book is a most careful compilation and should prove to be of great use as a reference book on these particular biological effects, even though there is very little direct reference to their significance in modern radiotherapeutic methods.

Dynamics of Airplanes and Airplane Structures. By Prof. J. E. Younger and Prof. B. M. Woods. Pp. xiii + 263. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 17*s.* 6*d.* net.

This is distinctly an American students' textbook that has no counterpart in Great Britain. It is obviously the work of skilled mathematicians, who have applied their knowledge to the investigation of some of the peculiar problems of the aeroplane. They have evidently treated their subject *multum in parvo*, and have rigidly resisted the temptation to stray from the application of mathematics to the problems before them, into the more philosophical outlook, which is so often the case with books of this description. The reader's taste will decide whether or not this is an advantage. This narrow outlook is not an ideal training for the student, but on the other hand it must be admitted that the authors do 'deliver the goods' and in a volume of reasonable size. Judged from the point of view of the English educational system, it is recommended for reading to a student who, having already studied the fundamentals of aeronautics, will benefit by approaching the subject from a somewhat different point of view, before taking up the deeper detailed investigations, as published in monographs such as the Aeronautical Research Committee Reports and Memoranda.

The text is divided into three parts. Part 1, "Simple Dynamics of Airplanes", deals with mathematical principles, and uses the aeroplane for the provision of illustrative examples. Part 2, "Advanced Dynamics of Airplanes", treats the various aspects of the machine in flight, including a useful study of stability. Part 3, "Special Problems", deals with special problems such as dynamic loading, periodic oscillations, vibration, flutter, etc., all of which are handled according to the most modern accepted theories.

The book has a useful decimal system of reference, both in paragraphing and numbering of formulæ, which makes cross-reference particularly easy. The index refers to page numbers.

Mendelism and Evolution. By E. B. Ford. Pp. xii + 116. (London: Methuen and Co., Ltd., 1931.) 3*s.* 6*d.* net.

This little book presents with great clearness and precision the actual position of modern genetics in its relation to the problem of evolution. It represents a review of the whole field of the subject and of the most important theories developed around it in recent years. Each aspect of the problem is considered with reference to a wealth of data, which should prove invaluable to students who have not

the time to collect for themselves the information rather widely scattered in the literature of the science, and necessary to obtain a grasp of the present state of the problem.

In a preliminary chapter the fundamental laws of the particulate theory of inheritance are crisply and clearly set forth, for which those who have not made a study of genetics will be grateful. The interaction of heredity and environment is then considered, with special emphasis on the internal environment provided by the gene complex. This is aptly followed by a review of the theory of the evolution of dominance and recessiveness. The question of the rôle of the cytoplasm in inheritance is well handled, and the adequacy of Mendelian inheritance to sustain the processes of evolution is demonstrated. The importance of geographic and also of genetic isolation with regard to the origin of species is well illustrated. Mr. Ford has, in fact, treated a very many-sided subject in a remarkably thorough and satisfying manner. A glossary which includes all technical words not explained in the work itself places this excellent book fully within the appreciation of the layman.

Chemistry in the Service of Man. By Prof. Alexander Findlay. Fourth edition. Pp. xviii + 355. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 6*s*. net.

WRITERS have called this a chemical age: it is certainly a period of chemical evolution, and side by side with a rapid advance in the science of chemistry there is great progress in its application to material things. Every layman participates in the benefits, and it behoves most of us to have some understanding of the how and the why of them. The conversation books of a former generation taught us in an entertaining way of the fruits of the earth and even of chemistry: to-day they are replaced by such books as that of Prof. Findlay, now in its fourth edition. He has somehow achieved the task of compressing everything into a very small compass, and yet produces a book which is eminently readable by an average person who seeks to enlarge his curiosity after the works of Nature. It is a book which should be widely read: in a more enlightened age one would expect a long notice of it to be treated as a feature by the literary reviews--surely a knowledge of what things are is of more importance than the history of a particular period, or the life of an eminent statesman, soldier, or courtesan? E. F. A.

Handbuch der Pflanzenanatomie. Herausgegeben von Prof. K. Linsbauer. Lief. 27. Abt. 1, Teil 2: *Histologie.* Band 4: *Die Epidermis.* Von K. Linsbauer. Pp. viii + 284. (Berlin: Gebrüder Borntraeger, 1930.) 29·40 gold marks.

THE section of this handbook upon anatomy that deals with the epidermis has been written by the editor of the series and might serve as a very good example of such encyclopædic work at its best. The epidermis is considered from the point of view of the morphology and detailed structure of the individual cells, with special sections upon the thickening and pitting of the wall and of the wavy contours that characterise the anticlinal wall in many cases, etc.

The chemistry of these membranes—slime formation, lignification, the nature of the cuticle and of wax excretions—receives very adequate attention.

The protoplasm of the epidermal cells and the various inclusions that have been reported are fully dealt with. The development and regeneration of the epidermis are adequately treated, so far as is permitted by the lack of attention these problems have had up to the present. The function of the epidermis leads to a full treatment, as an absorbing system, of the root surface and of the root hairs, but such physiological subjects, as also theories of light perception by epidermal cells, are only considered so far as they have led to re-examination of structural features of epidermal tissues. The root hair receives much attention when considering the epidermis as an absorption system, but the epidermis as a protection against evaporation receives less attention, and the problem whether hairs on the shoot epidermis hinder or help evaporation is left alone. Stomatal apparatus is evidently excluded from the scope of the monograph.

Studies on the Genus Pythium. By Velma Dare Matthews. Pp. v + 136 + 29 plates. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1931.) 13*s*. 6*d*. net.

MISS V. D. MATTHEWS' book gives a very complete account of the genus *Pythium*. The author collects information of the methods and media for culture, discusses distribution and habit, the production of mycelium, sporangia, conidia, zoospores, and sexual organs, and considers taxonomic characters. The genus *Pythium* is taken as it was originally established by Pringsheim, though its vicissitudes since that time are also enumerated. A key to the species is given, and each one is described in detail, with such physiological characters as are known. The host-range is also enumerated, and the book includes twenty-six plates of line drawings and an extensive bibliography. The academic or economic mycologist will find the book a useful work of reference.

Agricultural Policy in South Africa. By Prof. H. D. Leppan. Pp. 101. (Johannesburg: The Central News Agency, Ltd., 1931.) 6*s*.

PERHAPS the chief interest of this book is the summary of the natural conditions in South Africa: the accounts of the soil, climate, water problems, and others. Few countries in the world are more interesting to students; within a comparatively short range one finds the moist temperate climate of the southern part of Cape Province, the semi-arid conditions of the Karroo, the desert of Griqualand, the open steppe-like country of the veldt, and the tropical luxuriance of northern Natal. Farther north comes the park-like country that stretches away to the equator and beyond. All these natural features react on the agriculture and bear on the agrarian policy best suited to the country. The author's discussion will be found of interest, even to those not particularly concerned with the agricultural industry.

Radio Observations during the Total Solar Eclipse of Aug. 31

THE radio observer of eclipse phenomena is subject to one important limitation which at once denies him the most spectacular successes and safeguards him from the most acute disappointments of the optical observer. He cannot make direct observations on the solar phenomena, but is restricted to a sort of indirect photometry of the ionosphere, a region already subject to such wide and ill-understood variations that no completely conclusive determinations are likely and no fully satisfactory control observations possible. At best, then, the agreement between the temporal sequence of radio phenomena and the sequence predicted from theories of the media will give strong support to one of the competing theories; at worst, a correlation of substantial magnitude will be submerged in random variations.

The eclipse of Aug. 31 was ill-situated, in place and time, for the mitigation of these difficulties. The line of optical totality did, indeed, fall happily for detailed observation, but totality was reached at a time of day when the diurnal curve of ionisation density in the ionosphere was already likely to be falling steeply, so that the temporary withdrawal of the ionising effect of ultra-violet light could only make the existing slope steeper, and the renewal of the effect could only be referred to a lower datum point. The centre line of the anticipated particle eclipse [1] was likely, on any probable assumptions of particle velocity, to lie mainly over the ocean, and the only observing stations near the centre line (computed from the most probable velocity) were the necessarily under-manned and under-equipped Polar Year stations on the eastern coast of Greenland. These stations were still more heavily handicapped than were the American stations by the steeply falling diurnal curve, while western European stations were near the very sunset limit of eclipse, and consequently observed in the unstable and variable conditions which have, from the earliest days of radiotelegraphic observation, been known to characterise the sunset period.

The crucial problem to be examined was, of course, the discrimination between ultra-violet light and corpuscles as ionising agents for the two main regions of the ionosphere. There was substantial agreement that the Appleton region, above 200 km., probably owed most of its ionisation to ultra-violet light, but while Chapman inclined to the view that the Kennelly-Heaviside region, at about 100 km. height, was ionised by neutral solar corpuscles, Appleton and Naismith "accept ultra-violet radiation as one of the causes, if not the chief cause, of the ordinary diurnal replenishment of the ionisation in Region E" (the Kennelly-Heaviside region), and "regard the solar stream of neutral particles as causing the extraordinary effects on abnormal days". It may be remarked that further theoretical development of this view would appear to be necessary to account for the remarkably limited single range of height within which these mixed agencies develop maximal ionisation density. Further work must also take account of the redistribution in the horizontal of that ionisation which results from the injection of ionising agents into regions outside the vertical column of ionosphere directly sampled by the modern technique of short-base echo sounding. The replenishment of ionisation in the Kennelly-Heaviside region after sunset, noticed by Appleton and Naismith [2] in England, by Schafer and Goodall [3] in the United States, and by Ranzi [4] in Italy, may possibly be referred to this horizontal redistribution.

The radio observations made in connexion with the total solar eclipse of Aug. 31 were of three kinds. The first and most directly interpretable class contained short-base echo experiments designed to give direct evidence of the state of ionisation vertically above the experimental stations. These stations were, in some cases, existing research establishments, but the Canadian authorities set up special stations at points vertically under the lines of optical totality for the two principal regions (these lines lying somewhat south-west from the line of totality at ground level), and Canadian and United States expeditions also proceeded to points as far eastward as were conveniently attainable on the American continent, in order to sample the particle eclipse. The second class of observation was made on long distance signals specially emitted for the purpose on frequencies and trajectories chosen to enhance the relative importance of one or other of the ionised regions in its normal and 'eclipsed' states. The collaborations amongst the American Telephone and Telegraph Company in the United States and the Post Office and Department of Scientific and Industrial Research in Great Britain, and between the British and Canadian Marconi Companies, belong to this category. The third class of observation dealt with the quality of reception of signals normally available, and included the considerable body of amateur collaboration in two continents, the results of which will doubtless become available at an early date.

It need scarcely be said that detailed observational results and considered conclusions are not yet available for discussion. But by the courtesy of the many authorities concerned the preliminary data, specially communicated for publication in NATURE, may be summarised here. The data will be taken in geographical order, from the eastern fringe of the particle eclipse to the western fringe of the optical eclipse.

Dr. Van der Pol, observing at Eindhoven, was so situated that the particle eclipse (here regarded as an eclipse of 1600 km./min. particles) was partial only, and was overtaken halfway through by the incidence of ground sunset. It was, then, not surprising that in such unfavourable geographical conditions no marked anomaly in Kennelly-Heaviside layer conditions was observed during the eclipse.

The two stations of the Department of Scientific and Industrial Research, namely, the Polar Year station established, in co-operation with the British

National Polar Year Committee and the Norwegian Committee for Cosmic Physics, at Tromsö, and the Radio Research Station, Slough, were, despite their geographical separation of 1330 miles, similarly situated in respect of the particle eclipse, which ended about the time of local sunset at both stations. Prof. Appleton's station at King's College, London, and Mr. J. A. Ratcliffe's station at the Cavendish Laboratory, Cambridge, both working, as always, in close co-operation with Radio Research Station, formed with Slough a group of stations thus unfavourably situated in south-east England, each of which undertook a distinct section of a single observational programme of short-base echo work. The Post Office stations at Dollis Hill, Baldock, and Cupar, and the Slough station, participated similarly in a single programme of organised observation on trans-Atlantic radio channels.

The Tromsö observations were complicated by the fact that the ionosphere was in the process of recovery from a severe magnetic disturbance. Had the station been farther from the sunset fringe, this magnetic disturbance might have been of importance in the study of the particle eclipse, but the general result of the superposed conditions was that, on a preliminary survey at least, the Tromsö record gives no suggestion of eclipse effects.

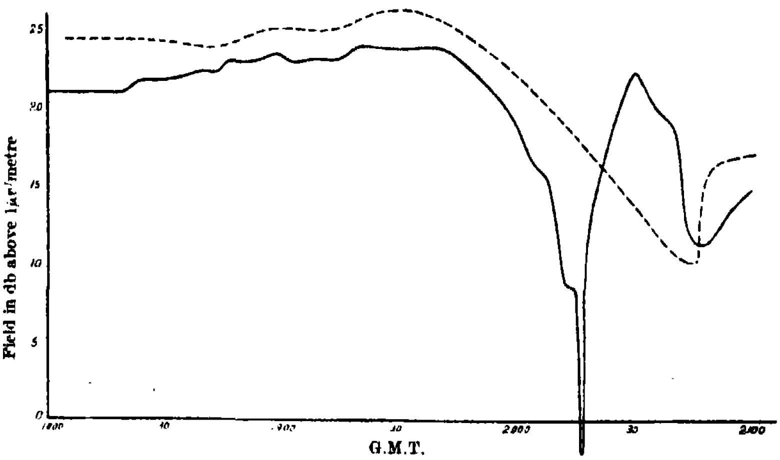

FIG. 1.—Field strength measurements taken at Cupar Radio Station on 60 kc./sec. of Rocky Point, U.S.A., transmissions. — — — — — Aug. 30; ———— Aug. 31.

The results from Cambridge, London, and Slough may conveniently be considered together. Cambridge and London, concentrating special attention on the Appleton layer, agreed in showing that the ionisation density in this layer increased between 1800 and 1900 G.M.T., suggesting that any effect of the particle eclipse on this layer was (1) over before 1815, (2) absent, or (3) overlaid by another cause of increased ionisation density. A notable decrease of ionisation observed by London about 1700–1720 might have supported (1), suggesting the eclipse of unexpectedly slow particles of low penetrating power, but the occurrence of a similar effect of less magnitude, on the succeeding control evening, was against this interpretation. On the other hand, Cambridge found that the electron density in this layer fell to a selected critical value, low enough to permit the escape of 70 metre waves, nearly an hour earlier on the eclipse date than on each of the adjacent control days. This time of critical value was confirmed by London. A slight rise in the effective height of the Appleton layer was observed at Cambridge at 1830 on Aug. 31. There are here two very slender suggestions that the cutting off of the corpuscular ionising agent permitted recombination to bring about an exceptionally early night condition, and increased the height to which it was necessary to proceed before finding a particular ionisation density.

Slough concentrated attention especially on the Kennelly-Heaviside region, about which Cambridge and London were able to supply confirming evidence. It is firmly established by the combined data that the ionisation density in this layer was notably lower in the late afternoon of Aug. 31 than on Aug. 30 or Sept. 1; the equivalent electron density being about 2×10^5 electrons per c.c. on both control days. At 1815 on Aug. 31 the value of $2{\cdot}5 \times 10^5$ was momentarily attained, but in general the value lay below $2{\cdot}0 \times 10^5$. At 1851 the density was below $0{\cdot}6 \times 10^5$, at 1905 this value was exceeded, and from 1940 to 2030 the average density was of the order of 1×10^5. There is, then, definite evidence of a relatively low ionisation density at the time of the particle eclipse, followed by a notable rise. This low density at 1830 has no counterpart on the control days, but the rise between that hour and 1900 is paralleled by the events of Aug. 30.

The British observations on trans-Atlantic signals were made on frequencies of 13,390 kc./sec. (wave-length 22·4 m.), 8665 kc./sec. (34·7 m.), and 60 kc./sec. (5000 m.) emitted from the stations of the American Telephone and Telegraph Co. at Laurenceville, of the General Electric Company at Schenectady, and of the American Telephone and Telegraph Co. at Rocky Point respectively. The 13,390 kc./sec. channel was watched at Baldock and Cupar, and the ray angles and state of polarisation were measured at Slough; the 8665 kc./sec. channel was watched at Slough; while the 60 kc./sec. channel was watched at Dollis Hill, Baldock, and Cupar.

It may be said at once that on the higher frequencies, no phenomena were observed which lay outside the normal range for the average afternoon; the impossibility of isolating any eclipse event on these channels is emphasised by a very great contrast in behaviour from one control day to another. A complete fade-out between 1951 and 2000 G.M.T. on Aug. 31 was observed on the 13,390 kc./sec. channel, but, as just indicated, no special significance can be attached to it.

The 60 kc./sec. channel, however, is subject to a

very much smaller range of normal variation, and the fact that this frequency range must involve the Kennelly-Heaviside region as an important element in propagation gave it an especially important place in the programme. Dollis Hill and Baldock did not observe any important anomalies on the eclipse date or on the control days. Cupar, on the other hand, experienced a complete fade-out between 2015 and 2018 G.M.T. on Aug. 31, followed by a recovery to a relatively high signal level at 2030. This sequence of phenomena was the only departure from a very close similarity between the variation curves for Aug. 30 and 31, as shown in Fig. 1. A complete fade-out of this type is such a rare event on the 60 kc./sec. channel that it is certainly significant, and the time of its occurrence, although somewhat surprisingly early, is so close to the time of minimum illumination of the lower ionosphere over the early part of the trajectory, that it may be concluded with some confidence that we have definite evidence of an ultra-violet eclipse effect on the Kennelly-Heaviside layer.

Details of the observations made by the Dutch and French Polar Year parties at Angmagssalik and Scoresby Sound respectively are, unfortunately, not yet available.

The Canadian joint observations are summarised in a special communication kindly cabled by Prof. A. S. Eve. The special expeditions sent to Vanleek Hill, Ontario, and to Kingston, Ontario, under the direction of Dr. J. T. Henderson and Dr. D. C. Rose respectively, report distinct losses in the ionisation of both the Kennelly-Heaviside and Appleton layers during the period of optical eclipse. The special expedition to Corner Brook, Newfoundland, also under the direction of Dr. Henderson, gives supporting evidence.

The observations at all three Canadian stations give no indication of any effect of corpuscular eclipse. The Nova Scotian expedition of the U.S. Bureau of Standards had not reported at the time of writing.

The Northern Electric Company found no intensity change in 500 metre signals between Ottawa and Montreal, while the Canadian Marconi Company found no definite changes which could be ascribed to the eclipse in 22·37 metre transmissions across the Atlantic.

Observations at the Bureau of Standards, Washington, revealed effects on both Kennelly-Heaviside and Appleton regions. The methods adopted enabled a measurement to be made of the critical frequency just capable of penetrating each region at vertical incidence. Penetration of the lower region would be indicated by a sharp change in the retardation time of the radio echo, from that corresponding to the lower region to the much higher value corresponding to the upper region. Penetration of the upper (and more highly ionised) region would be indicated by the absence of an echo on the relatively high frequency which had first penetrated the lower region without measurable reflection, but had still, below the critical value, been reflected from the Appleton region. The Bureau of Standards reports that the conclusions to be drawn from the observed effects on the Appleton layer are still under consideration. For the Kennelly-Heaviside layer, however, the critical frequency of penetration was lower by about 1000 kc./sec. at the end of optical eclipse than before and after eclipse. The minimum critical frequency was reached about five minutes after the maximum of partial optical eclipse at Washington. This decrease of critical frequency indicates that the partial ultra-violet eclipse at Washington, with a duration of about an hour and a half, was accompanied by a very slightly lagging reduction of something between 35 and 60 per cent in the density of ionisation in the Kennelly-Heaviside region.

The provisional conclusions to be drawn from this assembly of data may now be summarised.

Optical Eclipse.—The evidence from the U.S. Bureau of Standards, National Research Council of Canada, and British Post Office establishes beyond any doubt the importance of ultra-violet light as a principal ionising agent for the Kennelly-Heaviside layer.

The evidence from Canada establishes a similar ultra-violet effect for the Appleton region, and the Bureau of Standards data probably support this evidence.

The evidence from European short-base echo stations was not expected to bear on the optical eclipse, nor does it do so.

Particle Eclipse.—No evidence is yet available from the only stations even moderately favourably situated for observations on the effects of the particle eclipse.

The Canadian and United States stations, unfavourably situated in place (and the Dutch station, unfavourably situated in place and time), show no effects at all suggestive of particle eclipse.

The British stations, unfavourably situated in time, give very slight suggestions of effects from the eclipse of particles of velocity somewhat below the 1000 miles per minute assumed in the computations of track and time.

In the light of all available evidence, weighted according to situation, the significance of ultra-violet light as a principal ionising agent for the ionosphere as a whole is established; the possible significance of neutral corpuscles is not established, but is not wholly excluded; it remains to be tested under more favourable conditions and in the light of our rapidly growing knowledge of the climatology of the ionosphere.

This discussion opened with a summary of the defects, in time and place, of the 1932 eclipse from the point of view of ionospheric observation. It may appropriately close with an indication of the merits of a 1933 eclipse. Chapman has shown that the student of the ionosphere is less interested in the distinction between total and nearly total eclipse than is the astronomer. The annular eclipse of Aug. 21, 1933, is of sufficient magnitude in respect of ionisation effects, and it has the overwhelming advantage that maximum eclipse for light and for particles alike can be observed in inhabited land areas at times when the diurnal curve of ionisation

density in the ionosphere is rising comparatively slowly or is near a stationary point: that is, the optical eclipse might be observed in the morning, but well after sunrise, the particle eclipse near noon. The low latitude of the eclipse track suggests another considerable advantage, the eclipse phenomena unrolling at such a low speed that the cumulative effects on ionisation may well outweigh the 7 per cent defect in magnitude of the eclipse. It would appear most desirable that an adequate organisation should be worked out for observations on the optical eclipse near Delhi, with corresponding observations on the particle eclipse.

The Superintendent of the Radio Research Station, Slough, would be grateful for information as to the station of origin of pulse signals on a frequency of 3·56 mc./sec. (pulses at 50 per sec.) which were accidentally observed at Slough during the control experiments for the eclipse. The pulse signals ceased at 2020 G.M.T. on Sept. 1 and at 2100 on Sept. 2. The echo pattern, showing marked magneto-ionic splitting, was recorded simultaneously with that from local pulses; the comparison of distance and direction data might yield useful results.

[1] Appleton, *Observatory*, March 1932.
Appleton and Naismith, *Proc. Roy. Soc.*, A, **137**, 36; 1932.
Chapman, *Mon. Not. Roy. Ast. Soc.*, **92**, 413; 1932.
Miller, *Mon. Not. Roy. Ast. Soc.*, **92**, 421; 1932.
Appleton and Chapman, NATURE, **129**, 757, May 21, 1932.
[2] Appleton and Naismith, loc. cit.
[3] Schafer and Goodall, *Proc. I.R.E.*, **20**, 1131; 1932.
[4] Ranzi, NATURE, **130**, 368, Sept. 3, 1932.

Current Constructive Theories in Psychology *

By Prof. BEATRICE EDGELL

ON Aug. 29 there occurred the tercentenary of one who is often called 'the father of English psychology', John Locke, 1632–1704. His "Essay concerning Human Understanding" is primarily a theory of knowledge, not a system of psychology, but none the less there is much of psychological interest in the Essay, and it has had a profound influence on empirical psychology in the eighteenth and nineteenth centuries. We may regard it as a misfortune that what he described as a "historical plain method" should have been interpreted as a genetic study, and that his doctrine of simple and complex ideas should have been translated into a doctrine of psychological elements and compounds; but such has been the case. Historians trace a straight line of descent from the Essay of Locke to the "Analysis of the Phenomena of the Human Mind" by James Mill, and thus claim Locke as a founder of the Association school.

It may seem a far cry from 1632 to 1932, but I want to consider some of the differing constructive theories of learning and knowledge offered by the psychologists of to-day in the light of the unreconciled methods and principles which find expression in the Essay.

We find first and foremost in the Essay a confusion of logical and psychological analysis; secondly, we find a theory that attributes the union of discrete ideas to their accidental association in time, introduced as an afterthought to the theory that ideas are united by the perception of their connexion or repugnancy.

To begin with the confusion of logical with psychological analysis. As Prof. Gibson has pointed out in his book "Locke's Theory of Knowledge", at the time at which Locke was writing, the distinction between the elements of knowledge attainable by logical analysis and the simple beginnings of knowledge attainable by genetic study was a distinction which it was wellnigh impossible for a writer to draw. Growth and development were conceptions which had a very different colouring from what they have for us to-day. They were, moreover, conceptions which had no literal application to knowledge. Knowledge for Locke was a structure the validity of which could be tested by taking it to pieces. Just as a logical analysis of the ultimate items into which, say, a building could be resolved and an inquiry into the material out of which it arose might lead one to much the same catalogue of stones and beams, so a logical analysis of knowledge into its elements seemed to have the same issue as an inquiry into the beginnings of knowledge. That which is simple in its content is easily confused with that which is simple in its origin. It is this confusion which lays Book II. of Locke's Essay open to much misunderstanding. Having in Book I. denied that mind is possessed of ideas at birth, and having claimed that all knowledge is founded upon, and derived from, experience, Locke seems by his account of the 'simple ideas' of sensation and reflection and of the 'complex ideas' built upon them to be offering a psychological constructive theory of knowledge.

There is much of great psychological value in this second book: Locke's frequent appeal to concrete illustrations, his references to children and animals, the famous citation of Molineux's problem whether a man whose sight was only restored to him in adult life would be able to distinguish by sight between a sphere and a cube. The book also contains his striking chapter on retention, vivid through its analogies but of paramount importance for psychology by reason of the statement added in the second edition: "This laying up of our ideas in the repository of the memory signifies no more but this, that the mind has a power in many cases to revive perceptions which it has once had, with this additional perception annexed to them, that it has had them before, and in this sense it is that our ideas are said to be in our memories, when indeed they are actually nowhere; but only there is an ability in the mind when it will to revive them again, and as it were paint them anew on itself, though some with more, some with less difficulty; some more lively, and others more

* From the presidential address to Section J (Psychology) of the British Association, delivered at York on Sept. 5.

obscurely " (II. x. 2). Here there is a glimpse of a conception which might have done much to correct the atomism encouraged by the 'blank paper' and 'cabinet' metaphors in other passages. When mind is compared with an empty cabinet which is furnished by the simple ideas of sensation and reflection, simple ideas are being treated as the psychological origin of knowledge. When, on the other hand, Locke tells us that simple ideas are unanalysable, are not distinguishable into different ideas, and are those in which men agree when they clear away verbal misunderstanding, we have simple ideas as the materials of knowledge in the logical sense. If we look at the simple ideas listed together, we find the same confusion: the items 'colour', 'sound', 'pleasure', 'pain' might be interpreted as psychologically simple, but what of the items 'existence', 'unity', 'power', 'succession'?

In his account of complex ideas, Locke starts with what purports to be a psychological account of how they are formed—namely, the operations of compounding by putting together several simple ideas, and of abstracting by "separating them from all other ideas that accompany them in their real existence". These operations are set side by side with the operations of comparison and seeing relations. Locke holds that such operations are not present in animals. The complex ideas of animals are apparently combinations of simple ideas given to, not made by, the animal. "They take in and retain together several combinations of simple ideas, as possibly the shape, smell and voice of his master make up the complex idea a dog has of him, or rather are so many distinct marks whereby he knows him; yet I do not think they do of themselves ever compound them, and make complex ideas" (II. xi. 7). These operations of mind in building complex ideas are never brought into clear relation with the operation which constitutes knowledge—namely, "perception of the connection of and agreement, or disagreement and repugnancy, of any of our ideas". Cutting across his attempted psychological account of how complex ideas come to be formed, Locke gives a logical classification of complex ideas according to the nature of their object or reference: there are ideas of modes, of substances, and of relations. In this we have another example of the confusion of the psychological and the logical point of view, or shall one say of transition from one to the other without any realisation of the change in outlook?

No orthodox psychologist from the time of Wundt onward would have admitted for a moment that his acceptance of sensations as psychological simple elements was due to logical analysis. He would have declared that it was due rather to the analysis of physiological events, namely, the simple stimulation of a sensory receptor and the resultant excitation of the central nervous system.

I question whether any psychologist who sets out from simple sensations is really determined by a search for what is primitive in experience. That we do not experience simple sensations as such is, of course, admitted on all hands; when treated as elements they are often said to be reached by 'hypothetical' analysis. What I want to suggest is that such analysis is the outcome of logic, not psychology. The method implies that perceptual knowledge is a structure, the logical analysis of which will yield the bricks out of which it is made. This is a teaching derived from Locke's Essay. The use to which the Association school put Locke's theory of association rests on this doctrine. The theory is given in a section added to the fourth edition of the Essay, and was put forward as a theory to explain strange aversions and likings, prejudices and errors. It is never put on a level with the synthetic processes of knowledge wherein there is perception of a relationship between ideas. Association is thus primarily a way of uniting items which are discrete and have no intrinsic connexion with one another.

Gestalt psychology to-day is never tired of proclaiming itself as a revolt from associationism. Even if we believe that associationism in pure psychology is dead, how far may it, nevertheless, be true that *Gestalt* is fighting a present-day attitude of mind which had its historical foundation in Locke's confusion of logical analysis with an inquiry into psychological genesis?

Gestalt psychology would claim that no constructive explanation can be satisfactory which sets out from such elements as sensory events or reflex responses, and attempts to build up the experienced phenomena of human awareness and behaviour by the synthetic method. Perceptual awareness of a situation and responsive behaviour must, on its view, be taken *in toto*. The explanation of why just 'this' is perceived rather than 'that', must be sought in the physical constitution of the immediate environment and in the total condition of the organism. The school sets itself the task of studying the conditions in the stimulating situation which determine the perception of this pattern rather than that. It is always the pattern or configuration as a whole which has to be explained. Much experimental work has been done and valuable information obtained, particularly in the field of visual perception.

Whereas for the 'orthodox' school—if there is still a school capable of claiming this adjective—'meaning' in the form of memory images, actual or potential, comes in as an ingredient in the complex perception of an x, for *Gestalt*, meaning may lie in the nature of the sensory pattern or total organisation. To take an example, size or shape perceived in indirect vision is not 'apparent' size or shape modified by the memory of 'real' size and shape; the size or shape actually perceived is due to the sensory pattern of the whole field.

It is 'organisation' which for *Gestalt* replaces the conception of association. The so-called association of contiguity is never mere collocation in time or space. It is always an instance of organisation. "Organisation is not at all an aggregation of indifferent material. . . . If association is a consequence of organisation, it must also depend upon the mutually relative properties of what is or shall be organisated" (Köhler, "Gestalt Psychology", p. 211).

When we turn to the question, How do organisations arise ? we may not be wholly satisfied with the answers at present forthcoming. There are the sensory organisations or patterns the conditions of which are being experimentally investigated. Here the relative importance of the environmental and the intra-organic factors stands in need of elucidation. Descriptive terms such as 'closure', 'nearness', 'pregnancy', 'symmetry' summarise the present formulations of experimental findings. There are also the organisations said to be created intentionally. Here the 'self' and 'attitudes' are called in as explanatory concepts, and with them we pass over into a speculative region of tensions and dynamic relations in the brain field, a somewhat misty region in our present state of knowledge.

The contemporary representatives of Locke's doctrine of association are the behaviourists. According to this school, man is born with certain native responses to definite conditions in his environment: his unconditioned reflexes. He 'learns' or acquires new responses when an original response is extended to a different situation or when an original situation is made to evoke a different response.

This acquirement is the result of 'conditioning'. All conditioning depends upon the temporal arrangement of the factors in the stimulating situation and upon the structure of the animal's nervous system. Conditioning is a scientific formulation of the facts noticed by Locke as association. "Custom settles habits of thinking in the understanding, as well as of determining in the will, and of motions in the body: all which seems to be but trains of motions in the animal spirits, which, once set agoing, continue in the same steps they have been used to; which, by often treading, are worn into a smooth path, and the motion in it becomes easy, and as it were natural . . . and are therefore called so, *though at first they had no other original but the accidental connexion of two ideas*, which either the strength of the first impression, or future indulgence so united, that they always kept company together in that man's mind as if they were but one idea" (Essay, II., xxxiii., §§ 6 and 7). In the language of behaviourism, such a man is 'conditioned' to respond to the second idea as he originally did to the first. As in associationism the complex phenomena of mind were constructed from the simple ones by association, so in behaviourism all the complex phenomena of human behaviour are constructed from the simple units of reflex responses by conditioning. Behaviourism presents us with a tidy system wherein everything hangs together. The whole of man's thought (speech) and conduct is theoretically capable of being explained deductively from his original reflexes subject to conditioning.

There are other contemporary schools wherein association figures as a great principle of linkage, but in each of them some condition over and above bare sequence is recognised. In the psychology of Prof. McDougall, association by bare contiguity has a place, but he also lays great stress on the learning that implies a thread of purposive interest. The *a*, *b*, and *c* that are associated together are members of what Prof. Stout terms a 'conative unity'. This interest would be an essential feature in the experience acquired in working out any instinctive tendency. Membership of a purposive whole is in principle a radical departure from association by temporal contiguity.

In psycho-analysis there is again great emphasis on association and its opposite, dissociation. The old forms of association, contiguity and similarity, are retained, and much use is made of them in explaining transference, trains of ideas, complexes, but the operation of association links appears to be completely controlled by instinctive and emotional dispositions. The machinery of association is the same as in the older doctrines, but the levers are operated by forces which lie quite outside the ken of association psychology.

Association figures also in the motor theory of consciousness, and here it would seem to be more after the old pattern. All association is between movement systems. Contiguity and similarity must be interpreted as contiguity and similarity between the systems of incipient and overt movements involved in the associated ideas.

We have said that Locke left his afterthought, his union of ideas by association, unreconciled with, or unrelated to, his account of knowing. Knowledge is the perception of the connexion of and agreement, or disagreement and repugnancy, of any of our ideas. In Book IV. he gives us a classification of the kinds of connexions and repugnancies we thus perceive: identity, relation, co-existence or necessary connexion, real existence. It would be out of place to go into the details of each class. What is at once apparent is that in all varieties of knowing the knower is perceiving some kind of relation between his ideas. They are synthesised or united in virtue of a perceived agreement or repugnancy.

If we turn to contemporary psychology, we may compare this doctrine with the principles of cognition laid down by Prof. Spearman. Prof. Spearman calls his qualitative principles of cognition 'noegenetic'. He claims that they and they alone are generative of new items in the field of cognition. Familiar as these principles may be, I will venture to quote the second and the third. The second is the principle of the eduction of relations: "The mentally presenting of any two or more characters (simple or complex) tends to evoke immediately a knowing of relation between them". The third is the principle of the eduction of correlates: "The presenting of any character together with any relation tends to evoke immediately a knowing of the correlate character". These two principles make the knowing of relations the basic fact of cognition. They are the key to intelligence.

Prof. Spearman would agree with *Gestalt* psychologists in stressing organisation. He differs from them by regarding organisation as dependent upon perceiving characters as related. All organisation or synthesis depends ultimately upon cognised relations. He thus denies sensory organisations as

simple data. By his second principle he necessarily repudiates association in the Lockian sense. Although he keeps the names of the old laws of association, contiguity and similarity, he states explicitly that "quasi-mechanical reproductive adherence has its source in the noetic coherence". In principle, reproduction by association and the eduction of correlates are akin. The distinction is that in reproduction the relata have already been related in past experience, the organisation is old, whereas in eduction of correlates the educed correlate is new. It is this aspect of his third principle in creating new knowledge that Prof. Spearman wishes to stress, and it is just this stress that differentiates his principle from that of relative suggestion advocated by Thomas Brown in his "Philosophy of the Human Mind", 1820. Whether such a distinction of 'old' and 'new' is one that can be drawn in any absolute sense is a question that need not be raised in this connexion.

Locke left us with unreconciled methods and principles, and in connecting these with differing schools in contemporary psychology, I may seem to be emphasising divergencies of doctrine. Indeed, I may seem to be giving support to the gibe that to-day there is no psychology, only a collection of psychologies. By many this is thought to be a sure sign of decadence. At first sight there is much in the present situation which may give rise to a sense of disappointment to those of us who belong to the older generation. The present century opened full of hope—psychology was emerging as a new science. It was being recognised as something distinct both from philosophy and from physiology. It was rapidly developing a technique of its own. All was 'set fair' for the growth of the 'new' psychology. It is true there were schools in a very limited sense. There was Leipzig, Göttingen, Paris, Harvard, Cornell, etc., but the lines of cleavage represented, say, at the Paris Congress of 1900, were but deep furrows in a common experimental field. To-day the schools appear to be separated by unbridged gulfs. Yet it is little more than fifty years since Wundt opened his laboratory in Leipzig, and fifty years is a brief interval in historical retrospect.

Is the present division of theory really a bad sign? Does it indicate the 'petering out' of the spirit which animated the workers from 1879 to 1900, or is it a sign of vigour? I believe there are good grounds for believing the latter alternative. Prof. Woodworth, in his book "Contemporary Schools of Psychology", declares, "all the schools are emphasising something that demands emphasis and serve a useful function in the progress of psychology". The methods and principles which find a place in Locke's Essay may demand for their reconciliation, not resolution but increase of knowledge, to enable us to mark out their respective spheres.

If Prof. Woodworth is right, we need reject no 'psychology' as false, but rather consider how far its particular teaching serves to explain certain aspects of complex human phenomena. This thesis can be illustrated by applying it to the data of experiments on recall.

Obituary

Mr. E. Edser

Many students of physics, as well as numerous friends in the world of applied science, will regret to learn that Mr. Edwin Edser died on Aug. 17, at sixty-six years of age, after a long period of acute suffering bravely borne. He was one of the most unassuming of men, yet everyone who knew him appreciated the breadth and depth of his knowledge of all branches of physics, and his clear understanding of fundamental principles used either in theory or in practice.

Mr. Edser was a student at the Royal College of Science, South Kensington, and obtained his associateship in physics in 1892, being top of the list. After a year of research he was appointed demonstrator in physics at the College, under Sir Arthur Rücker, and in 1895 became lecturer in physics and head of the mathematical department of the South-Western Polytechnic, Chelsea. Later, he was lecturer in physics at Woolwich Polytechnic, and from 1903 until 1914 was head of the Department of Physics at Goldsmiths' College, University of London.

While at the Royal College of Science, Mr. Edser carried out some notable pieces of research and was associated with Sir Arthur Rücker in an important paper on the objective reality of combination tones, read before the Physical Society in March 1895. The question of the objective existence of summation tones as distinguished from supposed beat tones, which had previously been the subject of much controversy, was proved conclusively by the experiments and results described in this paper.

Mr. Edser was an ingenious experimenter, and so long ago as Aug. 17, 1893, he contributed an article to Nature upon a simple arrangement of apparatus devised by him to illustrate Michelson's method of obtaining interference bands. The use of this apparatus in connexion with experiments on change of phase of light after reflection at a silver surface was described by him in an article in Nature of Sept. 23, 1897. Mr. Edser was probably one of the earliest experimenters in Great Britain to make use of the principle of Michelson's interferometer, and he applied it to investigate the effect of movement in liquids upon the velocity of light. He also used the instrument in an investigation with Mr. S. G. Starling on the effect of the electric discharge upon the velocity of light. In a paper read before the Royal Society in 1898, Mr. Edser developed Maxwell's electromagnetic theory of light so as to include dispersion, metallic reflection, and allied phenomena.

In a letter to Nature of May 2, 1912, concerning peculiar shadows cast by leaves during the partial solar eclipse of April 17, 1912, Mr. Edser made the

interesting observation that where a leaf was isolated from the bulk of the foliage, its shadow took the form of a crescent, thus actually being a negative image of the visible portion of the sun during its partial eclipse. In his inimitable way, he immediately devised a laboratory experiment to illustrate the phenomenon, and thus showed that when light from an extended source throws the shadow of a small object on a screen, under such conditions that the umbra of the shadow is not formed, then the shadow is the negative inverted image of the source of light.

Mr. Edser's textbooks on heat, light, and general physics are very widely known. He took special pains to make all his explanations as clear as possible, and many of the experiments described in his books were original and required only the simplest apparatus. When his textbooks were written, few science students of the standard for which they were intended were familiar with advanced mathematical methods, so the calculus was not used in them, and therefore some of the proofs now appear cumbrous from a more modern point of view. He was, however, very successful in presenting difficult parts of his subjects without making large demands upon the mathematical knowledge of students, though he was himself a good mathematician.

Since 1915 Mr. Edser's work was mainly concerned with the physical problems involved in flotation processes of mineral separation. One of his colleagues of Minerals Separation, Ltd., writes as follows:—"Much of his work in the investigation of the complex phenomena of flotation was published in the 'Reports on Colloid Chemistry' of the British Association, his more important contributions being 'The Concentration of Minerals by Flotation' (Fourth Report, Coll. Chem., Brit. Assoc. Rept., 1922) and 'Molecular Attraction and the Properties of Liquids' (*ibid.*). From the latter the following conclusions he arrived at may be quoted: 'Of the energy which represents the surface tension of a liquid 94% is located in the surface layer one molecule diameter in thickness, while the remainder is located at a greater distance from the surface'. And in respect of the Law of Molecular Attraction: 'Two molecules attract each other with a force that varies inversely as a power of the distance separating them, and this power must be higher than the fifth. In all liquids the result of analysing the experimental data is to indicate that the molecules attract each other inversely as the *eighth* power of the distance separating them, but mercury is not in good agreement with this law.' Some could have wished a wider audience for these papers than their present (virtual) burial place affords."

In several respects, Mr. Edser represented the best type of product of the physical laboratories of the Royal College of Science and the stimulating influence of Sir Arthur Rücker and Prof. C. V. Boys. He was not only fertile in ideas, but also skilful in all laboratory arts, and able therefore to devise and construct simple and effective apparatus to test or demonstrate them. Withal he was a delightful companion, an artist of considerable merit, and of catholic literary taste; and his memory will long be cherished with affection by a wide circle of friends.

News and Views

Report of Council of the British Association

THE report of the Council of the British Association, adopted by the General Committee at the York meeting, included several matters of particular interest. The period of the presidency, for example, now coincides with the calendar year instead of extending from one meeting to the next. The nomination of the new president is made known, however, on the first day of the annual meeting, and the General Committee accepted the recommendation of the Council that Sir Frederick Gowland Hopkins, president of the Royal Society, should be the president of the Association next year, when the meeting will be held at Leicester on Sept. 6–13. A notable change of policy with regard to allocations of grants to research committees was brought before the General Committee. For many years these grants have been made on a year-to-year consideration of available balances and have amounted to about £1000 annually. The general treasurer, Sir Josiah Stamp, in a memorandum upon the financial position and outlook of the Association, pointed out the weakness of this system and suggested that, for a time at least, not more than £400 should be expended annually from general funds on grants for research, and that an annual sum of £500 should be placed to a contingency fund. This recommendation was approved by the Council, which is of opinion that the true function of the Association, in making grants to research committees, is the initiation of particular pieces of research rather than their quasi-permanent endowment. In addition to the grants made from general funds at the annual meetings, the Council can deal at any time with applications for grants from the Caird Fund. Prof. J. L. Myres retires from the office of general secretary of the Association, which he has held since 1919, and the Council records its deep sense of gratitude for his devoted services. The two general secretaries are now Prof. P. G. H. Boswell and Prof. F. J. M. Stratton. The new members of Council are Sir Henry Dale, Dr. Allan Ferguson, Prof. R. B. Forrester, Dr. H. S. Harrison, Sir John Russell, and Prof. F. E. Weiss.

Social Consequences of Scientific Discovery

THE concern for the social consequences of the application of scientific discoveries which has been voiced by Dr. L. P. Jacks in a series of recent articles was reflected in several of the addresses and discussions at the recent British Association meetings. Dr. Jacks suggests that, instead of lending itself to the creation of endless desires, science might regard its task of giving man control over the forces of Nature as sufficiently advanced for the time being and turn its attention to the equally important task of assisting man to control himself. Recognition of this necessity was as explicit

in Sir Alfred Ewing's presidential address before the British Association as in the forceful address delivered by Prof. Miles Walker to Section G (Engineering), which referred frankly to the hampering of developments by vested interests and the middleman, as well as to the value of the contribution to the improvement of the lot of mankind made by those who possess the power of devoting their whole energy to the execution of sound, practical, and beneficent projects for the sake of those projects themselves and not primarily from selfish motives or in pursuance of some irrational prejudice. Long after science has shown the way to make things better for the people, unintelligent control and stupid prejudice preserve the old evils and prevent the spread of better ways. If effective action is to be taken, now that in so many fields physical science has instructed man how to control and eliminate waste, the human sciences must show him how to control the waste forces of his own nature.

As an example of the potentialities, Dr. Jacks and Prof. Miles Walker both refer to Lord Baden-Powell's discovery of how the play-hunger of the young human animal, his love of adventure and fun, his sporting instincts, and even his devilries, can be used by skilful hands for the development of self-control, self-respect, courage, loyalty, discipline, good fellowship, responsibility, and competence. This is a great discovery, to be ranked with any of the achievements of physical science, and is a token of what may be possible when we really address ourselves to the development of the social sciences. The picture Prof. Miles Walker draws of the State as controlled by the engineer, with the elimination of waste at its source, the control of production, improvement of distribution so as to secure the manufacture of things men want and their distribution in the simplest way with the minimum addition to the cost, involves drastic curtailment of competition and perhaps a profound change in our social habits and attitude towards buying and selling. In insisting on technical knowledge and administrative ability as a qualification for public office, he is, however, expounding a doctrine freely voiced in NATURE for many years, and the proposed experiment of a small, relatively self-supporting community is one that should not be without appeal to scientific workers. The time is opportune for courageous and adventurous experiment. The world has yet to receive an object-lesson in the high standard of life which should be possible by good organisation and modern methods, where prejudice and incompetence are no longer allowed to deny to society the benefits of leisure or material possessions with which the application of scientific discoveries would endow them.

Political Economy and Unemployment

THE confusion which exists in many minds between creative science and mechanical science is apt to obscure the contribution which creative science makes towards the solution of the unemployment problem, a contribution which, under modern conditions, is the more important because so many of the new industries, which fundamental scientific discoveries have created, minister to the increasing leisure needs of mankind. The escape of output from limitations of human effort, resulting from power production, has economic consequences which are already so far-reaching that, in the physical sphere, creative science can do little more than mitigate the severity of unemployment, and Mr. H. R. Leech, of 10 Dale Street, Runcorn, has rightly directed our attention to the necessity for original and creative research in that most uncreative of sciences—political economy. It is only as political economy and all the related so-called human sciences are placed on a firm scientific foundation, and as scientific methods are rigorously applied to the analysis of the problems of distribution of leisure and goods with which we are confronted in the age of incredible abundance which science has given us, that we can expect to solve an unemployment problem of the present magnitude. When impartial solutions have been mapped out by scientific methods, there will still remain for scientific workers and others the moral responsibility of seeing that those solutions are applied, and that the profusion with which science has now endowed mankind is no longer permitted to exist side by side with such widespread unemployment, poverty, and distress.

Scientific Research and Industry

THE Committee appointed in March 1931 by the Economic Advisory Council to examine the project for promoting new industrial development in Great Britain by establishing a central national research organisation independent of existing Government and private organisations, has just issued its report. This gives a survey of the existing organisation of industrial research in Great Britain and an analysis of the arguments for a new national research organisation, as well as of proposals for a development fund for the Department of Scientific and Industrial Research, a compulsory levy for support of research associations, and the preparation by Government of scientific digests. The Committee is satisfied that the existing Government organisation for the promotion of industrial research is efficient and sufficiently flexible to enable it to develop along the lines required to meet the changing needs of industry. The formation of a new national research organisation would cut right across the existing organisation of the Department of Scientific and Industrial Research, and, by causing confusion of purpose and distraction of effort, would be likely to injure rather than forward the cause of scientific research in British industry.

Research Development Fund

THE Committee considers it is highly desirable that the Government should have at its disposal a small fund for research development, and that provision should be made for its continuance when the balance of the fund at the disposal of the Advisory Council for Scientific and Industrial Research is surrendered to the Exchequer at the end of the current year. The Committee refers to evidence received as to the value of the services rendered to industry by the research associations, and trusts that it will be possible for the Government to continue to provide sufficient financial assistance to secure their efficient functioning until industry

is in a position to bear the whole of their cost. At the same time it is considered that if an industry can produce a practicable scheme, Government assistance in obtaining Parliamentary powers for a compulsory levy should be forthcoming. We hope to discuss this Report in more detail in due course.

Liebig and Faraday at York

It is one of the benefits of international intercourse that visitors to a country often record in their letters and diaries their impressions and memories of men and institutions, for which we cannot be too grateful. From these records we get those glimpses of the past which often escape the historian. Thus from the memoirs of Bishop Taylor of Norwich we can picture the aged Haüy—who looked like a man picked out of a crystal—lecturing at the Jardin des Plantes, where, "as everywhere also, the utmost liberty is shown to all, but to Englishmen particularly your country is your passport"; while from the letters of Helmholtz we see Tait "a particular form of savage" at St. Andrews, where, devoted to golf, he could only be brought to talk of rational matters on a Sunday. Of all the men of science who visited England in the early days of Victoria, none was better known than Liebig, who was at York for the 1844 meeting of the British Association, and afterwards toured Great Britain in the company of Playfair, Daubeny, and Dean Buckland. After his return to Giessen, Liebig wrote a charming letter to Faraday, which was long treasured by the late George B. Buckton, and which through the kindness of Miss A. M. Buckton was published in full in the *Times* on Aug. 31. During this year's meeting of the British Association the letter has been on exhibition, and Miss Buckton proposes to send it to General Smuts, as a contribution to the newly built Witwatersrand Library. It is stated in the *Times* that the letter has hitherto been unpublished, but perhaps it should be pointed out that it was printed in W. A. Shenstone's "Justus von Liebig, his Life and Work", published by Messrs. Cassell and Co. in 1901. While Liebig's letter contains an interesting view of British science at the time, Frank Buckland has left us an equally interesting contemporary account of the happy surroundings in which Liebig lived and worked at Giessen.

Founders of the Royal College of Chemistry

The memory of Liebig is also revived by an article, accompanied by a reproduction of a daguerreotype of five of his assistants, contemporaries in his laboratory at the University of Giessen, all of whom were pioneers of chemistry, which appears in the *Times* of Sept. 5. Three were German—Hofmann, Fresenius, and Will—and two were English—Gardner and Bullock, who were associated in 1845 in the foundation of the Royal College of Chemistry, of which Dr. Gardner was secretary and Hofmann the first professor of chemistry. That three of the chemists associated with the Royal College of Chemistry in its early days should be included in a single photograph will be of special interest to past and present students of the Royal College of Science, its lineal descendant. "Ninety years ago", says the writer of the article, explaining the picture, "five young men met for a solemn function. . . . They met to be photographed." He gives a list of the distinguished chemists trained by Hofmann at the College, of whom Prof. H. E. Armstrong survives.

The Chinese Earthquake of Aug. 14

An earthquake of considerable severity occurred in the south-west of China at about noon (Chinese time) on Aug. 14, and was registered by seismographs throughout the world. From the records at six observatories, the officials of the U.S. Coast and Geodetic Survey place the epicentre in about lat. 27° N., long. 103° E. (Wire Report of Science Service, Washington, D.C., Aug. 16). This point lies near the northern boundary of the province of Yunnan, about seven hundred miles to the south of the province of Kansu, in which the destructive earthquakes of 1920 and 1927 occurred. Kansu is a thickly populated province, and it is possible that some thousands of lives may have been lost, though weeks may elapse before news reaches us from the central district. From the beginning of the sixteenth century, it has been visited by twenty disastrous earthquakes, by one of the latest of which, in 1888, about five thousand persons were killed. According to Mr. N. F. Drake (*Amer. Seis. Soc. Bull.*, vol. 2, pp. 40-91; 1912), the province of Yunnan is one of the most important earthquake districts of China. He represents the relative seismicities of the four principal districts—Fukien, Kansu, Chihli, and Yunnan—by the numbers 100, 98, 94, and 91.

The Rubber Industry in Malaya

The rubber industry of Malaya is passing through the most critical period which it has yet experienced, so that the issue of a special rubber number of the *Malayan Agricultural Journal* (vol. 20, part 5) is of particular interest. The recent decision against compulsory restriction of rubber growing, though a disappointment to many, has, by removing the element of uncertainty, enabled the estates to frame their policy more clearly. Under-consumption rather than over-production is the cause of the present crisis, so that it is hoped to rectify matters by more intensive production on areas actually in tapping, and by improving the liaison between the scientific investigator and both producer and consumer. Already great reductions have been effected in the cost of production. Factory improvements, such as the construction and installation of batteries of light sheeting machines in cascade or file formation instead of in line, have facilitated and accelerated the handling of the coagulum, and more rapid methods of drying and smoking have been evolved. Economy has also resulted by the use of treated hessian for packing in place of the usual wooden chests. Considerable increase in the export of latex continues, and the extended application of this form of product to new uses is a hopeful sign of development on at least one side of the industry. Every effort is being made to study the best methods for growing and manuring the crop and for controlling the various diseases and insect pests which attack the rubber plant, so that when the industry

emerges from its present difficulties it seems reasonable to believe that a standard of efficiency of production will have been achieved such as was undreamt of in the prosperous time which formerly prevailed.

Briquette Method of Reafforestation

A SOMEWHAT novel method of sowing tree seeds is alluded to by Prof. Svend Heiberg, of the Department of Sylviculture of the New York State College of Forestry at Syracuse, in a Science Service Bulletin, dated June 29. Prof. Heiberg has been studying forestry methods in Europe, and was interested in a new type of seed-sowing developed in Norway which he terms " planting forests by the brick instead of by the tree ". The seed bricks or briquettes are made of good soil and are $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. in size. Three or four seeds are placed at one end, near the surface. The briquette is then dipped in paraffin wax, except the side in which the seeds have been placed. The result is an easily transported product, which can be placed in the ground by means of a special tool designed for the purpose. A machine can turn out 16,000 briquettes in a day. Prof. Heiberg suggests that the idle lands of the United States may be reafforested by planting briquettes instead of trees. He has been experimenting with this new system of planting or sowing at the College, but has not yet had time to decide upon its successful possibilities. He realises that the method would only be practicable on bare land free of heavy weed growth. In the absence of any figures of cost and of data of success achieved, it is not possible to compare the cost of the method with ordinary broadcasting or patch sowing; but Prof. Heiberg is probably correct to a point in stating that " In the reafforestation of comparatively clear fields the briquette system will do away with tree nurseries. It has other important advantages. It permits the root system to develop normally and also avoids disturbance of the roots at the time of planting "—though these latter apply to all tree seed-sowing.

Tuberculosis in Cattle

THE eradication of tuberculosis from cattle herds is the subject of a recent article by James Mackintosh (*J. Roy. Agric. Soc.*, vol. 92), who, besides describing the steps already taken in England and other countries to reduce the incidence of this disease, offers some practical recommendations as to how it may be more effectively stamped out. Although eradication by means of vaccines designed to confer immunity is still in the experimental stage, the testing and separating of reactors from non-reactors has met with success in northern European countries and seems to be the most hopeful method for adoption in Great Britain. Greater uniformity is, however, desirable in the application and interpretation of these tests. The measures taken under the Tuberculosis Order, 1925, to destroy all animals suffering from 'open' tuberculosis having failed to attain their object in time to be of real value, amplification of the order is recommended so as to ensure a general systematic inspection of cattle, by means of which tubercle-free beef and dairy herds may be built up, with a possible development in the future of definite 'accredited' areas. In this respect the Milk (Special Designations) Order has been of definite use by providing the only official recognition in Great Britain for herds which have been tested and contain no reactors. The practicability of such a scheme as that issued by the National Veterinary Medical Association is made evident, and the cost, if shared by the State, the local authorities, and the farmer, should not be heavy, whereas the benefit to the cattle industry and the community in general would be very considerable.

Cockles of the Thames Estuary

IN the *Southend Standard* for Aug. 4 and 11, Mr. Laurence Wells describes the local cockle industry, and has collected much valuable information (" The Cockle Industry of Leigh." Part I., " Early Use of the Cockle as Food and the Rise of the Industry at Leigh-on-Sea ". Part II., " Natural History, Distribution, and Economics "). The natural knowledge of the fisherman is extensive. From experience and from observation he has acquired an intimacy with the ways of the cockle which would put many a naturalist to shame. Spawning time, free-swimming larvæ and the effects of the weather on them, their growing stages, and the strange sounds made by the young under the sand are all known to them. To the different parts of the animal he gives special names. He knows that if conditions are unfavourable the cockles may migrate to more pleasant surroundings. Cockles have been collected at Leigh for more than 150 years. To-day the industry is thriving and affords work for a number of men and women. The sand-banks and flats of the Thames estuary afford a habitat admirably suited to the needs of these bivalves, from Shoebury Sands for the whole length of the Maplin and Foulness Sands, known collectively as the " Maplins ". The Leigh men also work along the Kent side as far as the Whitstable Flats; for 60,000 cwt. of cockles, minus the shells, are demanded from them annually, valued at £11,000. The boats are of a special design and peculiar to Leigh. The cockles are collected with a special rake and are cooked, according to law, in a steam oven, before being sent to market. Apart from the sale of the cockles themselves, there is a thriving industry in by-products from the shells. A complete account of the cockle, both historical and biological, is given in Mr. Wells's interesting article.

Electric Power and Village Industries

THE 'Sofina' (Société Financière de Transports et d'Entreprises Industrielles) controls a large number of industrial undertakings in all parts of the world. In its third annual report, interesting data are given of the rapid increase in the rate of the substitution of small electric motors in place of hand power in certain districts in France. In the St. Etienne district, for example, the small workshops have increased more than fifty times during the last seven years. The number of looms in 1925 was 214, but it has now increased to more than 11,000. In the Roanne district, the number of family weaving workshops has trebled in nine years. Home workshops for machining cycle parts have increased greatly all over France. It is pointed out that this substitution has enabled the

family workshop to compete against the large factory. In the Jura department, communal workshops have placed four hundred electric lathes at the disposal of the woodworkers. This utilisation of electric power by cottages has an effect in keeping the country dwellers from drifting to the larger cities, and thus mitigates some of the social problems which many nations are finding so difficult at the present time. In Great Britain, the transmission system—the grid—will soon supply cheap electric power to several country districts. In these districts it will be possible to establish suitable village industries on a commercial basis. In time this should have the effect of easing the economic crisis. Probably training schools for craftsmanship will have to be established. If electric power is sufficiently cheap, small electric motors should enable the weaving industries to flourish in villages.

Studies of Geophysical Methods, 1928 and 1929

The Geological Survey of the Canadian Department of Mines has published, as *Memoir* 165 (Ottawa, pp. 225; 1931. 45 cents), a valuable account, under the above title, of an impartial investigation of various methods of geophysical prospecting. Electrical methods were applied in 1928 to the Abana mines property, Quebec, by generous permission of the owning company, and three electrical prospecting companies accepted an invitation from the Geological Survey to demonstrate their methods on this comparatively suitable deposit; the work was done at their own expense, under the observation of officers, both physical and geological, of the Survey. The geological, electric, and magnetic surveys showed that the physical conditions existing in the Abana mineral deposits are complex, but that, nevertheless, the magnetic and electric methods of prospecting, when used intelligently, are feasible and productive of valuable results. The work in any new area must still be to a large extent an original research, requiring the use of highly trained and skilled men. Further work on the Abana property, and elsewhere, was done in 1929, partly in co-operation with the U.S. Bureau of Mines and (in gravity work) with the Dominion Observatory of Canada. At the Errington Mine, Ontario, an area was met "for the first time" where, in the present state of our knowledge, geophysical methods were of small avail, and where the diamond drill under the direction of geologists and mining engineers was the sole guide to further discovery.

Actinometric Bibliography

The Association of Meteorology of the International Union for Geodesy and Geophysics, at its Stockholm meeting in 1930, gave a subvention for the preparation of a bibliography, or rather a series of short abstracts, of papers on actinometry. These are prepared under the supervision of M. Wehrlé, secretary of the Association, at the French National Meteorological Office, by M. Volochine; where possible, the abstract is provided by the author, and English, French, and German versions of the abstracts are available, at the choice of subscribers. Each abstract is on a single leaflet, of convenient size for binding; the leaflets are well reproduced by lithography from typescript. The normal annual number of leaflets will be 300-400, but the bibliography is to be retrospective, covering the last thirty years; this work, involving about 2000 leaflets, being planned to occupy about two years. The leaflets are to be sent to subscribers in packets of fifty. Subscriptions are invited, though the amount of subscription will not be fixed until the demand for the leaflets is ascertained; it is expected, however, to be about 120 francs per year (for 400 leaflets), and 600 francs for the retrospective bibliography (for 2000 leaflets). Intending subscribers should write to M. Wehrlé, at l'Office Nationale Météorologique, Paris.

Turquoise Mosaic Plaque from Chichen Itza

A mosaic plaque of turquoise and jade, it is announced by Science Service, of Washington, D.C., has been discovered under the Castillo mound, in the ruined city of Chichen Itza, Yucatan. This announcement recalls the discovery, also at Chichen Itza, of a similar plaque—one of the most remarkable objects of the art of the ancient Mayas ever found—which was made in 1928 by an expedition sent out by the Carnegie Institution of Washington. This plaque was made of turquoise mosaic on a foundation of wood, which had perished. The services of a museum expert were requisitioned from New York for its removal. The operation of salvage, which necessitated the improvisation of a special technique on the spot, took three months to complete. The plaque was exhibited for the first time at the International Congress of Americanists which met in New York in September 1928. The plaque which has recently been found is described as a mosaic of turquoise and jade, and, like the preceding find, is on a foundation of wood, now decomposed. It lies in a stone box under a number of fragile articles not yet removed. The tomb under the mound appears to be a secondary burial, and turquoise spearheads may indicate that the occupant was a warrior.

Announcements

The Alexander Pedler Lecture of the British Science Guild will be given this year, under the joint auspices of the Burton-on-Trent Natural History and Archæological Society and the Guild, at Burton-on-Trent on Nov. 4, by Prof. F. T. G. Hobday, principal and dean of the Royal Veterinary College, London. Prof. Hobday's lecture will be entitled "Animals as a National Asset and Responsibility". The Norman Lockyer Lecture of the Guild will be delivered on Nov. 22 by Sir Frank E. Smith, secretary of the Department of Scientific and Industrial Research.

Applications are invited for the following appointments, on or before the dates mentioned:—A lecturer in electrical engineering at the Leicester College of Technology—The Registrar (Sept. 12). A lecturer in physiology for education students at the University of Leeds—The Registrar (Sept. 15). A lecturer in physical chemistry at Auckland University College, University of New Zealand—The Secretary of the Universities Bureau of the British Empire, 88a Gower Street, W.C.1 (Oct. 10). An assistant bacteriologist at the Royal Institute of Public Health—The Secretary, 23 Queen Square, W.C.1.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Altitudes to be Reached by Air Pilots by Breathing Oxygen

SCHROTTER (1904)[1] gives the following figures:

Altitude.	Pressure.	Tension of Oxygen if Pure Oxygen were breathed.
11,000 m.	190 mm. Hg.	25 per cent of an atmosphere.
14,500	127	16·6
17,000	93	12·5
20,000	76	10

At normal atmospheric pressure, most people can bear a reduction of oxygen from 21 to 12·5 per cent of an atmosphere without distress, but if the tension of water vapour in the lungs is, as assumed by Schrotter, 47 mm. of mercury, and that of carbon dioxide 30 mm. Hg, a total pressure of 77 mm. Hg, then at 17,000 m., where the pressure is 93 mm. Hg, the tension of oxygen, even when pure oxygen is breathed, must be far too low to support life, namely, $93 - 77 = 16$ mm. Hg. Argyll Campbell found that animals could live when the tension of oxygen in the lungs fell to 50 mm. Hg, but degeneration of the heart and other organs resulted on prolonged exposure to this tension, which is one-third of the normal, and corresponds to that at the top of Everest. We know how very distressed the best climbers became on reaching 28,000 feet; two lost their lives, never returning from their final effort to reach the top.

On repeatedly exposing 4 mice, 7 rats, 2 guinea-pigs, 1 rabbit, and 2 goats in chambers to oxygen (about 98 per cent) and evacuating the chambers, I found all these animals to be not distressed when kept for five minutes or more at a pressure of 100 mm. of mercury, but to be uncomfortable at 90 mm. Hg, and prostrated, or convulsed, at 85-70 mm. Hg. The experiments were carried out in special chambers and with vacuum pumps and animals (goats) kindly placed at my use by Sir Robert Davis at the works of Messrs. Siebe, Gorman and Co., Ltd.

Very conclusive evidence was obtained from the two goats. When the pressure sank to less than 100 mm. Hg, each goat licked its lips and moved a little as if uneasy; at about 90 mm. Hg each lay down; at about 84 mm. Hg a convulsive movement due to want of oxygen was apparent. All the animals recovered at once on letting in more oxygen and raising the pressure.

It is clear from these experiments that the total tension of water vapour and carbon dioxide in the lungs must be considerably lower than that assumed by Schrotter, at any rate at low atmospheric pressures. The tension may be reduced by better ventilation of the lungs. Haldane says the tension of carbon dioxide in the lungs may be halved at 35,000 ft., but he assumes the tension of water vapour to be 47 mm. Hg. This scarcely can be the case.

Schrotter put the limit of altitude attainable by air pilots with the help of breathing apparatus at 11,000 m. or a little above this figure. These animal experiments show that, given an efficient oxygen breathing apparatus and an hour, say, spent in breathing oxygen before the climb in order to wash out nitrogen from the body, a pilot might attain certainly to 50,000 and perhaps even to 55,000 ft. A pressure of 95 mm. Hg corresponds, according to Schrotter's figures, to 55,800 ft., and all the animals withstood decompression to this figure without serious signs of discomfort. It is noteworthy that Paul Bert (1878)[2] records that a sparrow decompressed in 92 per cent of oxygen fell over as if dying when the pressure was lowered to 75 mm. Hg.

LEONARD HILL.

[1] Schrotter, "Die Sauerstoff in der Prophylaxe und der Therapie", 1904.
[2] Bert, Paul, "La Pression barométrique" (1878).

The Practice of Dental Mutilation

IN NATURE of Aug. 20, p. 268, reference is made to a letter published in the August number of *Man* in which I state that the earliest evidence I could find of evulsion of teeth and other dental mutilations in Nubia could not be pushed back before about 300 B.C.

I have no reason for modifying that statement. Nevertheless, as Dr. Wilfrid Jackson reminds me in a personal letter, I overlooked the fact that there is evidence from other places to suggest that the practice of dental mutilations may be very much more ancient than the Nubian record suggests. In October 1914, Dr. Jackson published an article entitled "Dental Mutilations in Neolithic Human Remains",[1] in which he quotes evidence which seems to establish the fact that during the Neolithic period evulsion of the teeth was practised in North Lancashire and North Wales. Moreover, in this article he cites information suggesting the possibility of dental mutilations at the time of the Egyptian Middle Kingdom (about 1800 B.C.) on the basis of a skull of the twelfth dynasty in the Manchester Museum. Moreover, Dr. Douglas Derry describes a case which, so he claims, reveals dental mutilation in a late pre-dynastic skull from Lower Egypt, found by Sir Flinders Petrie. In view of this information, it is clear that I must modify the statement which I made on the basis of the Nubian evidence. The addition of fifteen (and possibly thirty) centuries to the antiquity of the practice of removing the teeth, if the somewhat sketchy data should be confirmed, will prepare the way for the elimination of certain difficulties in interpreting the evidence obtained by Miss Dorothy Garrod in the skeletons from Palestine regarded by her as mesolithic.

Dr. Wilfrid Jackson directs my attention to an article by Prof. Yoshikiyo Koganei[2] on the occurrence of dental mutilations in so-called stone-age Aino remains from the shell-mounds of Japan. I have the less excuse for forgetting this fact because two years ago, during my visit to Tokyo, Prof. Koganei showed me the actual specimens.

While none of the evidence which escaped my memory when I was writing my letter to *Man* is quite conclusive, its cumulative effect is to raise the possibility that the practice of evulsion of the teeth may be much older than I assumed to be the case.

In drawing inferences from sporadic instances of the absence of incisor teeth, the fact should never be overlooked that such deformations may easily be produced as the result of disease or accidental injuries inflicted by a process no more lethal or culturally significant than prize-fighting. In fact, it is doubtful whether the instances attributed to the Egyptian pre-dynastic period and Middle Kingdom are of any real significance as evidence of a cultural practice, and Dr. Wilfrid Jackson's Neolithic examples may possibly come into the category of accidental injuries.

G. ELLIOT SMITH.

Aug. 30.

[1] *J. Anat. and Physiol.*, vol. 49, p. 72; 1914.
[2] *Mitt. d. mediz. Fakultat d. Kaiser. Universität zu Tokyo*, Band 28, Heft 3; 1922.

Ionisation by Positive Ions

IN recent years many theories of discharges in gases have been proposed which do not afford a consistent explanation of the principal properties of currents obtained in gases under various conditions. According to a theory which has been much advocated,[1] it is said that atoms of the gas are not ionised by single impacts of electrons in discharges at pressures greater than that corresponding to the minimum sparking potential, since the electrons lose their energies in producing metastable atoms and therefore cannot attain the ionising potential. So far as the action of electrons is concerned, it has already been shown that this theory of collisions is inconsistent with the ordinary properties of glow discharges.[2]

Recent theories [3] also involve unsatisfactory hypotheses with regard to the action of positive ions in contributing to the conductivity.

In these theories it is maintained that atoms or molecules of a gas cannot be ionised by the collisions of positive ions unless the kinetic energy of the ions is of several thousand volts. Thus if the ionising potential of an atom be 10 volts, a hydrogen ion would require an energy of at least 4500 volts in order to ionise the atom.[4] It has therefore been concluded that in discharges where the potentials between the electrodes are less than a thousand volts, the action of the positive ions in contributing to the conductivity is limited to the liberation of electrons from the negative electrode, and in order to explain the corona discharge it was found necessary to assume that the emission of electrons from the electrode is independent of the energy of the positive ions acquired by moving under the electric force in the gas. The objections to these hypotheses as a basis of a general theory of discharges have been pointed out.[5]

The modern theories thus differ from the well-known theory of the disruptive discharge which was deduced from experiments made some years ago in the Electrical Laboratory, Oxford.

In this theory, in order to reconcile the results of the experiments on currents between parallel-plate electrodes with experiments on the corona discharges, it is assumed that molecules or atoms of the gas are ionised by the collisions of positive ions in discharges maintained by potentials of a few hundred volts, where a small proportion of the ions acquire energies of about twenty volts. When the electric force is small and the gas pressure is large, the rate of ionisation due to positive ions is very small, but it is increased when the force is increased or the pressure reduced. Thus the ionisation increases with the kinetic energy acquired by the positive ions in moving under the action of the electric force.

We have recently made direct experiments to determine the effects of positive ions in hydrogen, the apparatus being designed so that it was possible to separate the effects of the liberation of electrons from the negative electrode from the effect due to the ionisation of atoms of the gas. We find that the number of electrons generated by positive ions in a current between parallel plates depends on the electric force and on the pressure of the gas. There is a large increase in the number of electrons thus generated, corresponding to a small increase in the force with forces of the order of 100 volts per centimetre and pressures of the order of half a millimetre. Also with copper plates 2 cm. apart the number of electrons liberated from the negative electrode is small compared with the number of molecules of the gas that are ionised by the impacts of the positive ions.

These experiments show that the energies of the positive ions in the collisions in which molecules are ionised are of the same order as that of the electrons, so that the velocities of the positive ions in these collisions are of the order of one-hundredth of the velocities of the electrons.

These results therefore confirm the earlier theory of disruptive discharge, given in the treatise "Electricity in Gases".

J. S. TOWNSEND.
F. LLEWELLYN JONES.

Oxford, Aug. 18.

[1] T. R. Merton and J. G. Pilley, *Proc. Roy. Soc.*, A, **107**, 411; 1925. R. d'E. Atkinson, *Proc. Roy. Soc.*, A, **119**, 335; 1928.

[2] J. S. Townsend and S. P. McCallum, *Phil. Mag.*, **5**, 695; 1928. *Proc. Roy. Soc.*, A, **124**, 533; 1929.

[3] J. Taylor, *Proc. Roy. Soc.*, A, **14**, 73; 1927. K. Zuber, *Ann. Phys.* (12), **6**, 665; 1932.

[4] Sir J. J. Thomson, *Phil. Mag.*, **48**, 1, July 1924.

[5] J. S. Townsend, *Phil. Mag.*, **45**, 444, March 1923. L. G. H. Huxley, *Phil. Mag.*, **3**, 1056, and **4**, 899; 1927.

Polarisation of Echoes from the Heaviside Layer

ONE of the most fruitful methods of investigating the Heaviside layer is that originated by Breit and Tuve, in which a series of short impulses of the order of 0·2 of a millisecond in duration are transmitted and the direct ray and echoes reflected at nearly normal incidence are observed at a neighbouring station. The echo patterns observed are often very complex and it has been found that a single *F* layer echo, say, is often split into two fairly closely spaced components. This has been attributed by Appleton to the double refraction suffered by a ray in passing through the ionised regions of the upper layer.

The double refraction is caused by the earth's magnetic field. According to the theory, these two components should be oppositely circularly or elliptically polarised. A complete proof that the splitting of echoes is due to double refraction should involve a demonstration of this fact. A recent experiment, in which this result is clearly demonstrated, constitutes a striking proof of the magneto-ionic theory of radio transmission.

For the purpose of determining the state of polarisation of the downcoming waves, two separate vertical tuned loop aerials perpendicular to each other, as in a Bellini-Tosi direction finder, were used at the receiving end. These were coupled in the usual way to a search coil which fed the receiver. The output of this actuated a cathode ray oscillograph in the normal way for demonstrating the echoes. The object is to use the double frame as a polarimeter. This can be achieved as follows: The aerial is set so that the angle between the two frames is bisected by the incoming direct or surface ray. The aerials are then tuned so that the currents in the two are in phase with the e.m.f.'s, which are also in phase. The search coil of the goniometer can then be set at 45° so as to receive no signal. The aerials are then mistuned, one being increased in natural period and the other reduced. When the e.m.f.'s in the aerials are in phase, the resultant is a rotating field in the goniometer and no position of balance can be found.

Consider a ray returned from the Kennelly-Heaviside layer: if this is circularly polarised, then the e.m.f.'s in the two frames will be 90° out of phase. If the mistuning of the aerials has been properly carried out so that the current in one is advanced 45° on the e.m.f. and retarded 45° in the other, then, when the e.m.f.'s are 90° out of phase, the currents will either be in phase or 180° out of phase, according to the direction of circular polarisation. It follows that for a circularly polarised wave a balance can be obtained with the pointer of the goniometer either at +45° or −45°, according to the direction of circular polarisation.

Let *A* and *B* in Fig. 1 represent the components of

the split echo represented on the oscillograph screen in the usual way. Then, when receiving with this polarimeter aerial, A will be enhanced and B reduced to zero and vice versa, according as the goniometer search coil is switched, say, from a $+45°$ position to a $-45°$ position, and the pulses A and B will 'see-saw' as the search coil of the goniometer is rapidly switched from $+45°$ to $-45°$.

In testing this arrangement, the expected results were immediately shown in a most striking way. The transmission was on a 60 m. wave from Writtle, near

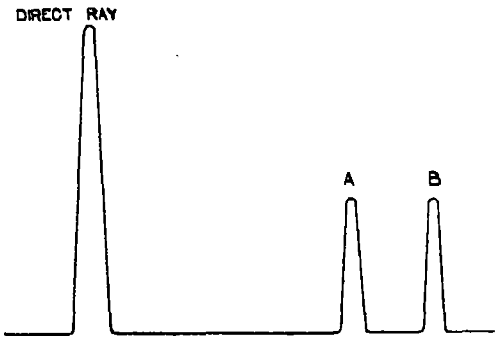

FIG. 1.

Chelmsford, to Broomfield, at a distance of 2·8 km., in which a series of pulses at a frequency of about 100 a second were sent out.

Split echoes were observed in the F layer reflections. With the aerials set up in the proper manner, switching the goniometer coil obliterated, in turn, first A and then B, producing the 'see-saw' effect expected. The results prove quite definitely that the two components are polarised in opposite directions. A knowledge of the adjustments made enables us to state that the most bent echo A is right-hand circularly polarised, looking along the ray in the direction of transmission, and the least bent echo B is left-hand circularly polarised. The arrangement enables one to examine the polarisation of each echo individually. So far as we have observed, the daytime echoes are normally right-hand circularly polarised.

This is in accordance with the view that in daytime on this wave the attenuation of the echo occurs mainly in the E layer, where according to theory the attenuation of the left-hand polarised ray should be more than twice as great as the right-hand polarised ray. This conclusion is confirmed by the observation that F_2, that is, a double reflection from the F layer, appears before the left-hand circularly polarised F_1. The arrangement should be of great help in interpreting the complex echoes that are often observed.

T. L. ECKERSLEY.

Research Laboratories,
Marconi Works,
Chelmsford, July 18.

Evidence of a Penetrating Radiation from Thunderstorms

WE have recently carried out experiments which suggest that a penetrating radiation is emitted by charged thunderclouds. In the arrangement used, one pen of an electric chronograph was actuated by a Geiger-Müller counter, another pen by a chronometer marking half-seconds, and a third by the atmospherics received from lightning flashes on a two-valve amplifier. The records have been examined to see whether the kicks of the counter and the flashes showed any significant time relations.

It appears that, during certain distant storms, the number of coincidences between counter-kicks and flashes is considerably more than can be ascribed to chance. Analysis of the distribution of counter-kicks in time around flashes shows that the number of kicks occurring in the particular interval of $\frac{1}{100}$ sec. which is centred on a flash exceeds the chance expectation by a factor which in the case of seven different storms varied from 3·3 to 11·4. In one case in which the counter was completely shielded by 20 cm. of iron the factor was 8·0.

Precautions were taken and tests were made to exclude spurious coincidences due to the interaction of the atmospheric and the counter amplifiers with each other, or to the direct action of the atmospheric Hertzian wave upon the counter amplifier. The seven storms which gave systematic coincidences were all at distances of 30-60 km. away; overhead storms did not show them. The results thus indicate that a thunderstorm emits some form of penetrating radiation at the moment of occurrence of a lightning flash, that this is emitted upwards and not downwards, and is received at distant points by some action such as that of the earth's magnetic field upon electrified particles.

To examine whether thunderclouds can produce such radiation *before* they are discharged by lightning, we have analysed the records of 21 distant thunderstorms (3200 flashes). The number of kicks of the counter was determined in the intervals 1, 2, and 5 sec. before and after the occurrence of each flash. The storms which gave systematic coincidences also show an excess of the order of 10 per cent in the forward as compared with the backward intervals. The probable error in the total count was 3 per cent. The other storms, which did not give systematic coincidences, show no significant effect here either, for they give a forward defect of 1 per cent while the probable error in the count is 2 per cent.

The geographical distribution of the storms which showed these effects is not easy to determine with certainty since what has been referred to as a storm is actually a record of several storms in different places. What information we have on this point suggests that the effective storms lay to the east of the meridian through the station.

Observations on overhead thunderstorms provided further evidence of the screening effect on the ordinary fine weather penetrating radiation which has already been reported by one of us.[1]

The experiments were made at the University of the Witwatersrand, Johannesburg. We wish to thank Prof. H. H. Paine for many kindnesses and to acknowledge the financial assistance of the South African Research Grant Board.

B. F. J. SCHONLAND.
J. P. T. VILJOEN.

University of Cape Town,
July 20.

[1] Schonland, *Proc. Roy. Soc.*, A, **130**, 37; 1930.

Viscosity of Nitrobenzene

WITH the intention of carrying out measurements of the viscosity of liquids, we have studied recently different experimental methods, and have come to the conclusion that, for relative measurements, the oscillating disc method permits of very great accuracy. Therefore we determine first the logarithmic decrement by registering the oscillations on bromide paper. The amplitude of the deflections could afterwards be measured with no great difficulty to 0·1 mm.

It seemed to us of great interest to investigate

nitrobenzene in the temperature range from 20° down to 6° C. by this experimental method. Besides the great relative accuracy obtainable with our method, there is another advantage; during the whole of the measurements, the liquid under examination remains completely separated from the atmospheric air. So we possess a rigorous control of the purity of the nitrobenzene during the measurements. We know from recent work published by other investigators that this precaution is absolutely necessary.

A few months ago, measurements with the same object were made by Massy, Warren, and Wolfenden.[1] They used the capillary stream method. The authors mention that in spite of the precautions taken, it was quite impossible to prevent the nitrobenzene from absorbing a small quantity of water.

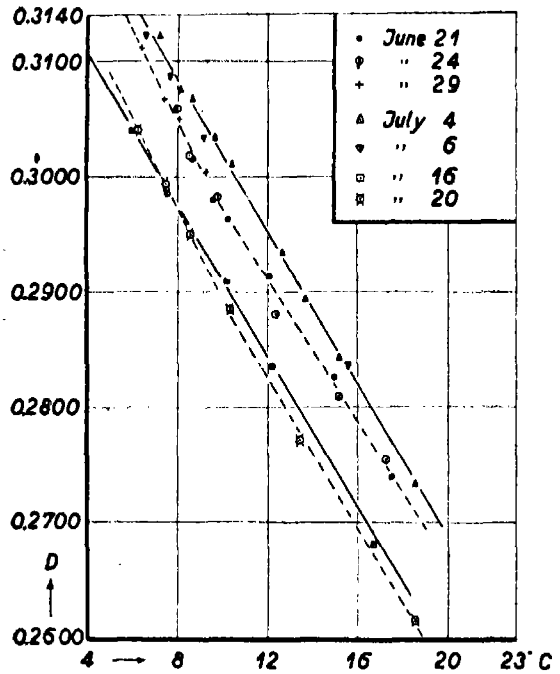

FIG. 1.

In consequence of the great accuracy of our method (0·05 per cent determined from the average error of the observations), we think it desirable to communicate our results. The experimental data are shown graphically in Fig. 1. The logarithmic decrement D has been plotted as a function of the temperature.

The measurements were made with two different oscillating systems (wire with different length). The points of the upper pair of curves correspond to the first oscillating system, those of the lower curves to the second one. Each point of the curve represents the average of about seven observations. The full lines correspond to the pure nitrobenzene,* while the broken curves correspond to nitrobenzene which was not absolutely pure and contains essentially water (m.p. 5·32° ± 0·02°).

The curve shows clearly, in both series of measurements, that for pure nitrobenzene the curves are straight lines with no discontinuous transition point. This result is in agreement with that obtained by Massy, Warren, and Wolfenden (loc. cit.), and also with the results established recently by other investigators, who measured other physical properties.

* This nitrobenzene was furnished by the Bureau Intern. d. Étalons physico-chimiques of Brussels. The melting point was guaranteed to be 5·70° (we found 5·70° ± 0·02° on a normal thermometer verified by the Physikalisch-technische Reichsanstalt).

For the impure nitrobenzene, the curves appear to be composed of two different straight lines, which cut each other in the neighbourhood of 9·6°. This experimental result agrees also with the suggestion put forward by other investigators and specially by Smits and Gerding,[2] that the phenomenon observed by Mazur[3] must be attributed to insufficient drying of the nitrobenzene, so that in the neighbourhood of 9·6° the nitrobenzene loses its absorbed water.

Finally we wish to direct attention to the parallelism between the straight lines corresponding to the pure and impure nitrobenzene. This can easily be explained since the oscillating systems differ only by the length of the suspensory wire, the rotating discs being the same.

A more detailed report about the experimental method and data will appear in *Wis- en Natuurk. Tydschr.*

A. VAN ITTERBEEK.

Physical Laboratory,
University of Ghent, Belgium,
Aug. 3.

[1] N. B. Massy, F. L. Warren, and J. H. Wolfenden, *J. Chem. Soc.*, 8, 91; 1932.
[2] A. Smits, *Z. phys. Chem.*, 160, 225; 1932. A. Smits and H. Gerding, *Z. phys. Chem.*, 160, 231; 1932.
[3] J. Mazur, NATURE, 126, 993; 1930.

Orienting Power of the Nitroso-Group and the Formula of Nitrosobenzene

THE nitroso-group in an aromatic nitroso compound appears to be chemically abnormal. Thus, in the case of nitrosobenzene, failure[1] to prepare salts or co-ordination compounds in which the nitroso-nitrogen acts as a donor atom, shows the accepted formula (1), with a tercovalent nitrogen atom, to be incorrect. Equality of the value of the dipole moment

$$C_6H_5 : \ddot{N} \vdots \dot{O}\!\!: \qquad (1) \qquad\qquad C_6H_5 : \overset{..}{\underset{\oplus}{N}} : \overset{..}{\underset{\ominus}{\underset{..}{O}}} : \qquad (2)$$

for this substance with that for nitrobenzene would indicate (2) as a possible formula, in which case the nitroso-group should be *meta*-directing in aromatic substitution reactions.

The available facts bearing on the orienting power of the nitroso-group are these: polymerisation of nitrosobenzene by sulphuric acid yielded not *meta*- but *para*-nitrosodiphenylhydroxylamine.[2] Nitrosobenzene has been *para*-nitrated[3] in carbon tetrachloride and chloroform, and *para*-chlorinated or brominated in carbon disulphide,[4] chloroform,[5] benzene,[6] and ether.[1] I suggest that all published experiments on the bromination in acetic acid solution[7] (the significant products of which have been bromoazoxybenzenes) also fall into line, because (1) these substances are not obtained from azoxybenzene and bromine under otherwise identical conditions,[1] (2) autodecomposition of mono- and dibromo-nitrosobenzenes is to be expected and should lead *inter alia* to bromoazoxybenzenes, and (3) qualitative indications have been obtained that the recovered nitrosobenzene contains traces of the *para*-bromo-derivative.[1]

Thus the nitroso-group appears to be *para*-directive, in conformity more with (1) than (2).

The nitroso-group has a strong labilising action on halogen atoms situated in the *para* position,[8] but its orienting nature cannot be inferred from this fact. Halogen activation and *meta* substitution are caused by the substituent radical in two separate ways: in the former a $-T$ effect (entirely absent during a substitution reaction) called up by the anionoid reagent, and in the latter a $-I$ effect accompanied by the

impossibility of $+T$ effects. The nitroso-group exhibits probably the strongest $-T$ effect yet recorded, but differs from nitroxyl, which can activate the halogen in *para*-halogenonitrobenzenes by virtue of the $-T$ mechanism (alkaline reagents), but which directs an entrant nitro-group into the *meta* position of nitrobenzene by reason of the permanent $-I$ effect, in that, by not possessing an ionic positive charge, $+T$ effects with the appropriate reagent will occur much more readily. *Para* substitutions take place by valency redistributions of this type occasioned by cationoid reagents; thus the direct *para* bromination and nitration of nitrosobenzene on one hand and the labilisation of bromine in *para*-bromonitrosobenzene on the other can be easily understood. The nitroso-group is unique but not anomalous.

A correct formula for this substance must, however, indicate more than (1) and (2) together show. Nitrosobenzene, like other Ar-nitroso compounds, possesses properties reminiscent of an odd electron molecule—for example, in some compounds the $-$NO group is apparently paramagnetic—and qualitatively resembles a free diarylamino-ion[8] in several respects. It thus is a case where ordinary chemical formulæ become inadequate.

A formulation involving a 3-electron bond has been implicitly stated by Pauling[9] which is satisfactory for unexcited nitrosobenzene (intermediate between (1) and (2)), which thus becomes (3)—which will, like the blue free diarylamino-radical, not only polymerise readily to a colourless dimeride (4) containing tercovalent nitrogen, but also will in different

$$\mathrm{Ph} : \overset{\cdots}{\underset{\cdots}{\mathrm{N}}} : \mathrm{O} : \qquad (3)$$

$$\begin{array}{l} \mathrm{Ph} : \ddot{\mathrm{N}} : \ddot{\mathrm{O}} : \\ \quad\;\; : \ddot{\mathrm{O}} : \ddot{\mathrm{N}} : \mathrm{Ph} \end{array} \qquad (4)$$

reactions exhibit opposite polarisations according to the requirements of the reagent. Incidentally, on these formulæ, both mono- and di-meric forms should produce *para*-substitution products, although the latter more easily than the former.

Pauling's arguments applied *mutatis mutandis* to the arsinoso-radical show that arsenic should be normally tercovalent, and that therefore no special analogy with the nitroso-group can be expected. An examination of 4-arsinosodimethylaniline has confirmed this.

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University College,
London, W.C.1.

[1] Unpublished experiments.
[2] Bamberger, Büsdorf, and Sand, *Ber.*, **31**, 1513; 1898.
[3] Ingold, *J.C.S.*, 516; 1925: and Bamberger, *Ber.*, **30**, 512; 1897.
[4] Ingold, loc. cit.
[5] Ham, *Dissert.*, Zurich, 29; 1904.
[6] Le Fèvre, *J.C.S.*, 810; 1931.
[7] Hammick and Illingworth, *J.C.S.*, 2363; 1930.
[8] Wieland, "Die Hydrazine", Stuttgart, 71; 1913.
[9] Pauling, *J. Amer. Chem. Soc.*, **53**, 3234; 1931.

Constitution of the Keratin Molecule

In dealing with my[1] comments upon their communication[2] under this title, Speakman and Hirst[3] describe as erroneous my statement that "the guanidine group of arginine does *not* . . . yield nitrogen with nitrous acid under the usual conditions". By "usual conditions" I naturally imply those generally adopted in determinations of amino-nitrogen in the course of protein analysis as described by van Slyke,[4,5] that is to say, contact between acid nitrate solution and amino-body at room temperature, for 3-5 minutes in the case of mono-amino acids and for ½-1 hour in the case of the hexone bases or proteins. Under these conditions the guanidine group of arginine is practically unaffected. The work of Plimmer[6] to which Speakman and Hirst refer is, of course, well known to me, and in that paper it is stated that any error introduced by reaction of the guanidine group of arginine in a 1-hour determination is inappreciable. With longer reaction times, correspondingly greater decomposition does occur.

In connexion with my second point concerning the importance of taking into account the amide nitrogen of wool in the calculations originally put forward by them, Speakman and Hirst have restated their case by assuming that all the arginine and lysine in wool is combined with glutamic and aspartic acids, and demonstrating that an excess of these acids would still be available to combine with 0·4 per cent of amide nitrogen.

The total amide nitrogen of wool, as determined by Marston,[7] is 1·2 per cent. No less than 0·8 per cent is thus left unaccounted for.

Speakman and Hirst consider that Abderhalden's figures for the proportion of dicarboxylic acids is low, but such a discrepancy would require that, in terms of glutamic acid, the figure at present accepted (12·9 per cent) is inaccurate by no less than 40 per cent in terms of weight, by 8·4 grams per 100 grams of wool. As I pointed out in my previous comments, Abderhalden and Voitinovici's[8] analysis of wool is the only complete one which is available, and I am glad to see that fresh determinations of aspartic and glutamic acids are being made in the University Laboratories at Leeds. Reliable data upon the composition of wool are sadly needed. Until these results are available, it is scarcely profitable to indulge in further speculation, although, considering the relative ease of the determination of the two dicarboxylic acids, either separately or together, I am surprised at the confidence with which Speakman and Hirst prophesy that errors of such magnitude as 40 per cent will be found in the figures we already possess.

Claude Rimington.

Onderstepoort Veterinary Research Laboratory,
Pretoria, South Africa,
July 13.

[1] Rimington, Nature, **129**, 580, April 16, 1932.
[2] Speakman and Hirst, Nature, **128**, 1073, Dec. 26, 1931.
[3] Speakman and Hirst, Nature, **129**, 938, June 25, 1932.
[4] Van Slyke, *J. Biol. Chem.*, **9**, 185; 1911.
[5] Van Slyke, *J. Biol. Chem.*, **10**, 15; 1911–12.
[6] Plimmer, *Biochem. J.*, **18**, 105; 1924.
[7] Marston, Council of Sci. and Ind. Res., Commonwealth of Australia, *Bulletin* 38; 1928.
[8] Abderhalden and Voitinovici, *Z. Physiol. Chem.*, **52**, 368; 1907.

Dr. Rimington has no new point to raise. Originally, he had two difficulties, one of which has apparently been eliminated by my reply to his earlier communication. As regards the second, his difficulty has been reduced to a doubt whether re-determination of the glutamic and aspartic acid content of wool will give a sufficient increase to account precisely for the amide nitrogen as well as arginine and lysine. Even this doubt must disappear in the light of Jones and Moeller's[1] determinations of aspartic and glutamic acids in various proteins. These authors state that "new determinations of these amino acids have been made in a number of typical proteins, and *invariably higher results for aspartic acid were obtained than those previously obtained by the ester method. In several cases from 4 to 9 times as much was found.*"

J. B. Speakman.

Textile Chemistry Laboratory,
University, Leeds,
Aug. 12.

[1] Jones and Moeller, *J. Biol. Chem.*, **79**, 429; 1928.

Preparation of Methyl *d*-Galacturonide

A PRACTICAL method for the preparation of methyl *d*-galacturonide from the commercially available polygalacturonide derived from citrus pectin [1] has been developed in my laboratory by Mr. Sam Morell.

On heating this polygalacturonide $(C_6H_8O_6)_n$ with absolute methyl alcohol containing dry hydrogen chloride, the glycosidic linkages are partially severed and the simultaneous formation of the methyl ester of methyl *d*-galacturonide occurs. The latter crystallises as the monohydrate, $C_6H_{11}O_5COOCH_3 . H_2O$, m.p. 138-140°; $(\alpha)_D^{25} = +124 \cdot 1$ in water where *c* may vary from 1-4 per cent; no mutarotation. The methyl ester can be converted in excellent yields over the barium salt ($C_6H_{11}O_5COOBa\frac{1}{2}$) to methyl *d*-galacturonide which crystallises as the dihydrate $C_6H_{11}O_5COOH . 2H_2O$, m.p. 112-114°; $(\alpha)_D^{25} = +127 \cdot 6$ in water where *c* may vary from 2-3 per cent; no mutarotation. In a private communication, Prof. Felix Erlich, of Breslau, Germany, has informed me that the polygalacturonide used in these experiments is identical with the tetragalacturonide "-a" $C_{20}H_{28}O_{16}(COOH)_4$ that he isolated first from beet pectin and afterwards from the pectin of various fruits.[2] The details of this work will be published elsewhere.

KARL PAUL LINK.

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[1] Link, K. P., and Dickson, A. D., *J.B.C.*, **86**, 491; 1930. Link, K. P., and Nedden, R., *ibid.*, **94**, 307; 1931.
[2] Erlich, F., and Schubert, F., *Biochem. Z.*, **168**, 263; 1926: **169**, 13; 1926: **212**, 162; 1929. Also, *Ber.*, **62**, 1975; 1929.

Prolongation of Pregnancy

RECENT experiments upon rats demonstrate that pregnancy can be prolonged by 4-10 days by any of the following treatments: implantation of anterior pituitary tissue (cattle), the injection of an alkaline extract of that gland, and of extracts of human pregnancy urine prepared by precipitation with barium-alcohol and/or phosphotungstic acid. Judged by the maternal weight curve, full development of the fœtus was reached at normal term, but the birth mechanism failed. Where pregnancy was prolonged for more than 3½ days, the fœtuses were invariably still-born; in several instances parturition was protracted for 12-70 hours. Since the ovaries of such animals were found, on biopsy, to be highly luteinised, prolongation was thought to be due to the persistence of the corpora lutea formed as the result of the treatment administered. Such was the view of Teel [1] and of Levin, Katzman, and Doisy.[2] There are, however, certain indications that another factor besides the corpus luteum is concerned in maintaining the conditions of pregnancy.

(1) Expulsion of a part of the uterine contents occurred in animals the ovaries of which were highly luteinised and in which no enlarged follicles were found on histological examination. The same ovarian structure was associated, in other cases, with a continuance of pregnancy.

(2) In 2 rats in which pregnancy had already been experimentally prolonged by 2 days, laparotomy showed the ovaries to be a mass of large follicles with no corpora lutea present; in one, 8 live fœtuses were *in utero*; in the other, parturition did not take place until 46 hours later. In a third rat in which this ovarian condition was observed at term, pregnancy continued for 5 days (until the 27th day) and the maximum weight of the mother was reached on the 26th day.

(3) Pregnancy continued for 3, 4, and 5 days respectively after both ovaries had been removed on the 22nd day of pregnancy (that is, normal term) in 3 rats which had been injected with a gonadotropic extract of human pregnancy urine; and underdeveloped fœtuses were born on the 21st and 23rd days in a rat similarly injected and bilaterally ovariectomised on the 16th day of pregnancy. Two others littered 46 hours and 55 hours respectively after ovariectomy.

The evidence suggests that a factor exists which may act upon the uterus independently of the ovaries, and preliminary experiments point to its origin in the anterior pituitary. An extract rich in growth hormone, prepared after the prescription of Van Dyke [3] and held by the latter to be free of gonadotropic hormone, caused pregnancy to be prolonged 4-6½ days when administered on or after the 11th day. It is to be noted that Schockaert [4] reports an effect on testicular development in the male duck and, in our own controls, when the growth hormone from as much as 2 grams of anterior lobe tissue was injected, numerous blood points formed in the ovaries of immature *mice*, but was without macroscopic effect on the ovaries of immature rats. This amount caused a prolongation of pregnancy in rats, as described. On the basis of the rat-unit being equivalent to 4 M.U. (Laqueur and de Jongh [5]), the effect on the pregnant rat was obtained at a lower level than that at which the immature mouse ovary reacted. The 4 : 1 ratio has, however, been disputed by d'Amour, Gustavson *et al.*[6] and by Coward and Burn [7]; it is, therefore, worthy of note that even 4 M.U. (taking a 'mouse unit' as the amount which produces blood points in the ovaries of immature mice weighing 8-10 gm.) of concentrated pregnancy urine extract did not prolong pregnancy in the rat. Yet further experiments are necessary before it can be stated that the factor responsible for the failure of the birth mechanism was not that which gave rise to the typical ovarian reaction; such experiments are being carried out. Since the existence of growth hormone in human pregnancy urine has been denied (Evans and Simpson [8]), this factor appears to be precluded.

At the present stage of the experiment, the indications are in favour of the existence of some substance, possibly in the anterior pituitary, and probably identical with neither gonadotropic nor growth hormone, which exerts an inhibiting effect upon uterine motility. That such may be the *modus operandi* of the unknown substance is indicated by Reynolds,[9] who induced a state approximating to complete quiescence in the œstrin-activated uterus of castrated rabbits by a single intravenous injection of pregnancy urine extract.

A. M. HAIN.

Institute of Animal Genetics,
University of Edinburgh, Aug. 4.

[1] Teel, *Amer. J. Physiol.*, **79**, 170; 1926.
[2] Levin, Katzman, and Doisy, *Proc. Soc. Exp. Biol. and Med.*, **28**, 873; 1930–31.
[3] Van Dyke and Wallen-Lawrence, *J. Pharm.*, **40**, 413; 1930.
[4] Schockaert, *Anat. Rec.*, **50**, 389; 1931.
[5] Laqueur and de Jongh, *J. Amer. Med. Assoc.*, **91**, 1169; 1928.
[6] Becker, Mellish, d'Amour, and Gustavson, *J. Pharm. Exp. Ther.*, **43**, 693; 1931.
[7] Coward and Burn, *J. Physiol.*, **63**, 270; 1927.
[8] Evans and Simpson, *J. Amer. Med. Assoc.*, **101**, 1337; 1928.
[9] Reynolds, *Amer. J. Physiol.*, **100**, 545; 1932.

Nuclear Magnetic Moments

As a possible explanation of the anomalous $g(I)$ factors of nuclear magnetic moments found in heavy and in light elements respectively by McLennan, McLay, and Crawford,[1] and by me,[2] it was suggested in both these papers that an orbital motion of some of the nuclear protons might fit the observed facts.

The recent important radioactive work proving the existence of the neutron affords, however, what may possibly be considered as an alternative or as an additional consideration. Bartlett [3] has shown that, starting with a helium nucleus, the continual successive addition of neutron, proton, neutron, proton, etc., up to O^{16}, and then neutron, neutron, proton, proton, etc., up to A^{36}, accounts exactly for all the existing isotopes; only He^5 is predicted also, but this has not yet been observed. It appears evident that α-particles, neutrons, and protons are the constituent elements of atomic nucleii. It is therefore quite possible that both neutrons and protons contribute to the production of nuclear spin. If the spin g factor of the neutron differs considerably from that of the proton, then 'anomalous' $g(I)$ factors will arise, for in one atom the nuclear spin may be largely due to protons, and in another due to neutrons.

The observations of McLennan, McLay, and Crawford may possibly be explained entirely by this alone, that is, providing the g factors are actually different; but the whole group of $g(I)$ factors, all anomalously too small, found by me in the lighter elements, is more difficult to account for. Perhaps orbital motion and variable g factor both contribute to the production of the observed anomalies.

S. TOLANSKY.

Imperial College of Science,
South Kensington, London, Aug. 15.

[1] J. C. McLennan, A. B. McLay, and M. F. Crawford, *Proc. Roy. Soc.*, A, **133**, 652; 1931.
[2] S. Tolansky, *Z. Phys.*, **74**, 336; 1932.
[3] J. H. Bartlett, NATURE, **130**, 165, July 30, 1932.

New Infra-Red Bands Photographed in the Absorption Spectrum of Acetylene

WE have recently investigated the vibration-rotation spectrum of acetylene in the near infra-red. This absorption spectrum has been photographed in the first order of the 21 ft. Rowland concave grating which has been recently set up in a Runge-Paschen mounting. Various lengths of absorbing gas have been used, namely, 3, 6, and 9 metres, at atmospheric pressure. Employing the new Kodak zenocyanine infra-red plates, we have been able to extend our investigations beyond 1μ.

In addition to the two bands at λλ7887 and 8622 A., which have been previously reported by Mecke [1] and also by Badger,[2] two further bands have been obtained situated at λλ10164·8 and 10369·8 A. units respectively, all bands being entirely resolved and showing alternating intensity in the lines. The first three of these bands are of approximately the same intensity, and all are far weaker than the band at 10369·8 A., whilst the band which Mecke reports at 7956 A. could not be detected.

The 10369·8 A. band is interpreted as the third harmonic of the fundamental frequency ν_3 (notation after Dennison [3]). It possesses strongly developed P and R branches and a weak line near the origin (very weak Q branch ?). A few rotational lines appear to be split up into very narrow doublets, a point which is being investigated further. The general appearance of the band is closely analogous to that of the 3μ band, in which case also there is evidence of the existence of a weak line near the origin.

The other bands quoted above are interpreted as $\nu_1 + 3\nu_3$ (8622 A.), $\nu_2 + 3\nu_3$ (7887 A.), and $\nu_3 + 2\nu_2$ (10165 A.). Again P and R branches are strongly developed, but no Q branch or doubling could be seen in any of these bands.

The present interpretation of the bands agrees with the theory of Dennison [3] that only odd integral multiples of the optically active frequencies can be seen in the spectrum, and that the combinations must involve at least one of these frequencies.

Full details of the present investigation will be published later.

W. LOCHTE-HOLTGREVEN.
E. EASTWOOD.

Physical Laboratories,
University of Manchester, July 28.

[1] K. Hedfeld and R. Mecke, *Z. f. Phys.*, **64**, 151; 1930.
[2] R. Badger, *Phys. Rev.*, **35**, 1438; 1930.
[3] M. Dennison, *Rev. Mod. Phys.*, **3**, 280; 1931.

Nuclear Structure

UNDER the above title, Mr. James H. Bartlett, jr.,[1] has indicated a simple regularity in the known nuclei of low atomic number, without being aware of the fact that I pointed out these regularities about a year ago.[2] He states: "The purpose of this note is to point out regularities for elements of low mass, and to suggest a possible building-up principle for such elements". The discussion of the next two paragraphs has been completely covered in the paper referred to above. The diagrams were made on the basis of building nuclei from protons and electrons, but the text pointed out that the building could be made from protons and neutrons very simply. This regularity was one fact which induced Dr. F. G. Brickwedde, Dr. G. M. Murphy, and me [3] to look for an isotope of hydrogen of mass 2, as stated in our paper. Moreover, in this paper we directed attention to this simple regularity among nuclei of low mass, and reproduced the proton-electron plot on page 14. It is only necessary to interpret each diagonal unit as the addition of a neutron and each vertical unit as the addition of a proton to secure the regularity pointed out by Mr. Bartlett.

I suggested further regularities beyond A^{36}. The regularity postulates the existence of many more nuclei than are observed, and it is, of course, a question as to whether these nuclei will be observed or not. There seems to be no particular reason at the present time for withdrawing the suggestions made, however.

HAROLD C. UREY.

Chemistry Laboratory, Columbia University,
New York, Aug. 16.

[1] NATURE, **130**, 165, July 30, 1932.
[2] *J. Am. Chem. Soc.*, **53**, 2872; 1931.
[3] *Phys. Rev.* **39**, 164: **40**, 1; 1932.

Oogenesis in the Indian Earthworm

RECENTLY my attention was directed to a paper by Vishwa Nath [1] on the shape of the Golgi apparatus in the eggs of the Indian earthworm, *Pheretima posthuma*. Unfortunately, Nath has apparently not seen my paper [2] on the same animal (*Pheretima posthuma*), in which I discussed the shape, origin, and structure of Golgi elements and mitochondria as observed in the oogenesis of this animal. Tests with osmic acid on fresh ovary or the usual fixed preparations failed to reveal the presence of either neutral fat or yolk; although in certain preparations swollen bodies resembling fat were found which were later on revealed as artefacts. The Golgi elements were of the usual spherical type with a definite osmiophilic thick rim and a clear transparent core inside. Prolonged osmication made the vesicle blacker. The mitochondria were granular and not filamentar. It is obvious, therefore, that Dr. Nath has completely confirmed my original findings.

U. S. SHARGA.

Rothamsted Experiment Station,
Harpenden, Herts, Aug. 18.

[1] Nath, Vishwa, "Studies on the Shape of the Golgi Apparatus: (11) Observations on the Fresh Egg of the Indian Earthworm, *Pheretima posthuma*", *Quart. J. Micr. Sci.*, **73**, 477; 1930.
[2] Sharga, U. S., "Cytoplasmic Inclusions in the Oogenesis of *Pheretima Posthuma*", *Alld. Univ. Stud.*, **4**, 177; 1928.

Research Items

Cars of the Gods.—The ceremonial car in prehistoric times and its modern survivals are fully illustrated and studied by Dr. R. Forrer in *Préhistoire*, No. 1. In tracing its various forms and analogies, the author propounds a new theory of the origin of the wheeled cart. According to his view, it was derived from the conceptions of the character and qualities of the sun held by man at the beginning of the age of metal. The sun was then regarded as a revolving disc, which was imitated for magical purposes by a wheel or disc. This wheel was made to revolve first by being thrown in the air, then by being attached to a forked stick, which was used to wheel it about. From this developed the two, three, and four or six-wheeled vehicle, which was used for religious processionals and was afterwards put to secular uses. The theory is supported by illustrative examples drawn from rock-paintings, grave furniture, vase paintings, and other material. In the course of time, the solar car of the spring festival was associated with models or miniatures. The occupants of the sacred car take various forms, not only that of deities, but also of symbols, such as the sacred pillar, which appears in an early cuneiform inscription from Boghazkeui, or a sacred bird or animal. There are examples in which the car bears a cauldron, which served as both a fertility and a rain charm. These developments appear in the Bronze Age, and by the Iron Age had spread all over Europe and even beyond. By the Hallstadt period, the ceremonial car was gradually disappearing in Europe, no doubt owing to the spread of other religious ideas. It would appear that it was the car rather than the deity that brought benefit to mankind, and it is the important element in the rite. As, however, the idea of anthropomorphism developed, the divinity assumed first place. The importance of the car wanes, while its secular uses extend.

The Northern Paiute.—In a report on the Northern Paiute of Fort Bidwell, Surprise Valley, north-eastern California (*Univ. Cal. Pub. Amer. Arch. Eth.*, vol. 31, No. 3), Miss Isabel T. Kelly states that there is little of the old life left. The seed-gathering and hunting, which were formerly the only modes of subsistence, have fallen into disuse. A few baskets are seen and a little skin-dressing done. Little information can be obtained about political institutions, though this may be due to paucity of development; but curiously enough, religion is still more or less flourishing. Shamanistic cures are in vogue and a number of the people frequent the sweat-lodges in order to pray to the sun. It is considered especially fit that one should sweat on Sunday—an interesting secondary association, which is deeply rooted. The sweat-lodge appears to be a recent introduction from the north, although the statement that it originated about forty years ago puts it too low. Other informants declared that they had always sweated. The sweat-house was used principally by men; a few women entered occasionally. Information on shamanism was obtained with difficulty only, as the shaman believes that he will sicken and die if he divulges information. It took the form of curing and, sometimes, of weather control. The antelope shaman officiated at ceremonial hunts. A certain amount of prophecy was also within the power of the shaman. Shamanistic power was acquired through dreams, often beginning in childhood, and to many coming unsought. Anyone who disregarded the 'call' of his dreams fell violently ill. A shaman controls various kinds of animal spirits, which come to him in dreams, the eagle coming most frequently. The usual correlation of the tambourine with the shaman does not exist here.

Ancestry of the Ferret.—The domesticated ferret was generally regarded as a descendant of the European polecat (*Mustela putorius*) until G. S. Miller suggested in 1912 that certain cranial characters pointed rather to descent from the Asiatic polecat (*M. eversmanni*). The latter view is challenged by R. I. Pocock, who finds that the skulls of ferrets do not resemble those of the Asiatic polecat in the particular likeness claimed by Miller, but differ from them in the position of the post-orbital constriction (*Scottish Naturalist*, p. 97, 1932). The skulls of ferrets, however, are nevertheless distinguishable from skulls of European polecats, but Pocock suggests that the differences are due to artificial conditions of confinement and of food due to domestication. His view is strengthened by the characters of an abnormally large 'polecat-ferret' found wild in Mull, for in it the skull resembles that of the European polecat, a resemblance attributed to reversion in natural conditions to the ancestral form of an individual which was probably a descendant, immediate or remote, of an escaped pregnant female ferret.

Baits for Sheep Blowflies.—Experiments to determine the responses of blowflies to chemical substances have been made by Martin R. Freney, at the instance of a special Blowfly Committee formed to deal with the many aspects of this serious problem in New South Wales. It has been found that wool fibre, consisting largely of the protein keratin, when hydrolysed with sodium sulphide, forms an attractive medium, and this substance was tested as a bait in fly-traps. According to the figures published (*J. Council Sci. Indust. Research*, vol. 5, 1932, p. 28), the small quantity of decomposed keratin (less than 5 gm.) was not so attractive as 50 gm. of fresh sheep's brain, but the results are stated to be without quantitative significance. They show, however, a qualitative selection, for the keratin bait caught a higher proportion of female blowflies, about 98 per cent as against 84 per cent upon carrion, and it proved to be more attractive to primary blowflies, the smooth maggots of which initiate strike, than to the hairy or secondary blowflies. This is an important difference, since the larvæ of the latter are enemies of the smooth maggots; and the raising of the primary maggot death-rate from 45 per cent for brain to 83 per cent for decomposed keratin is an achievement which merits further investigation.

Freshwater Flagellates.—The attention of students of the freshwater fauna is directed to a memoir (*Mem. Mus. Roy. d'Hist. Nat. de Belgique*, No. 47; 1931), by Dr. W. Conrad, on the flagellates recorded from a series of five ponds near Louvain as the result of observations over a period of three years. The Chrysomonadina are represented by 19 genera, including 52 species (7 new), and the Volvocales by 17 genera, including 44 species. In the genus *Chromulina* the author has given particular attention to the cysts, the characters of which he regards as forming the basis of classification, and he subdivides the genus into three according as the envelope is smooth, or ornamented with ridges more or less spiral, or with spines. Keys are given for aiding in the determination of the species, and six excellent plates in colour reproduce the author's drawings from the living specimens.

Plague in Egypt.—An interesting account of the third pandemic of plague in Egypt, by Dr. A. W. Wakil, has been issued by the Egyptian University (Faculty of Medicine, *Pub.* No. 3: Cairo, 1932). The first and second pandemics of plague in Egypt occurred in the sixth and fourteenth centuries, the third commenced in 1899 and is still continuing. Although cases have occurred every year, the total number has been comparatively small, numbering rather less than 20,000 during the thirty-two years. The bubonic type amounted to 83·9 per cent, the septicæmic to 8·9 per cent, and the pneumonic to 7·2 per cent of the total. Up to the present, the city of Cairo, though well suited in many respects for the occurrence of plague, has been practically immune from plague during the present pandemic with a total of only 16 cases. The cause of this immunity is ascribed to a biological factor, namely, the presence of numerous weasels which keep down the number of rats, the principal agent in spreading bubonic plague. The main species of fleas found upon all types of rats in Egypt is *Xenopsylla cheopis*, the principal vector everywhere of bubonic plague, which numbered about eighty per cent of the total rat-flea population. Graphs are given of the relations between the incidence of plague and of the abundance of rats and rat-fleas, which show the marked relation between these factors.

Economic Botany of Cacao.—A detailed study of "The Economic Botany of Cacao" has recently been published by Prof. E. E. Cheesman (Supp. *Tropical Agriculture*, June 1932). The systematic position of the genus *Theobroma* and the status of the species *Th. cacao* L. is reviewed. Many varieties—both botanical and horticultural—are described. The most important sections deal with requirements of light and other ecological considerations, and with descriptions of the branching systems, leaves, flowers, fertilisation, and fruit production. Much discussion is devoted to the genetics of cacao growing, and to the selection and propagation of good varieties. Physiological and pathological aspects of yield and problems of quality are investigated. The paper is mainly a summary of the literature on the subject and should prove useful to all who are interested in the cacao plant.

Chromosomes and Pollen of *Kniphofia*.—The chromosomes in several species of *Kniphofia* (Liliaceæ) have been studied by Mr. A. A. Moffett (*J. Genetics*, vol. 25, No. 3), who finds the basic haploid number to be six. In *K. Nelsonii*, unlike the other species, diploid, tetraploid, and octoploid tissues were found in the same plant, both in root tips and pollen mother cells. As in certain species of *Crepis*, some roots were partially diploid and partially tetraploid. In one flowering spike most of the cells, if not all, were tetraploid or octoploid, while other spikes were diploid. In species-hybrid, *K. corallina* has a few univalent meiotic chromosomes and fewer chiasmata than the other species, while in the tetraploid pollen mother cells above mentioned two to six quadrivalents, as well as univalents and trivalents, were found. Many giant pollen grains with $2n$ or $4n$ chromosomes were also found in *K. Nelsonii*, their frequency decreasing towards the top of the spike. The majority of such grains have four haploid nuclei, and they appear to be formed directly from pollen mother cells, through a failure of the process of furrowing by which the pollen grain walls are normally formed, but this does not necessarily involve failure of the spindle mechanism.

Geology of the Lupa Goldfield.—An important contribution to the geology of Tanganyika Territory has been made by Dr. D. R. Grantham as a result of three seasons' work in the Lupa Goldfield and its neighbourhood (*Bull. 3, Geol. Surv. Dept.*, 1932, with coloured gelogical map, 1 : 100,000). A long sequence of events, including repeated cycles of igneous activity, has been established: granulites associated with banded ironstones—basic flows and intrusions—foliation and *lit-par-lit* injection of the main granitic gneiss, *G*1—shearing—some of the older dolerites—Malwelo rhyolitic and trachytic series with basic lavas now represented by chlorite-schist—Ilunga felsitic series—gneissose microcline-granite, *G*2—older dolerites—Ilunga granite, *G*4—Saza granite with peripheral diorites and 'spessartites', *G*5—younger dolerites, probably Karroo—olivine-dolerites, possibly Cretaceous—peneplanation—rift-valley movements, Tertiary alkali-lavas, and deposition of lake-beds. The 'spessartites' are regarded as a differentiation product of the Saza hornblende-granite overcharged with doleritic inclusions. They have been found to carry gold, and it is suggested that the Saza granite is the parent of at least some of the gold reefs. The lowest of the step-faults producing the Rukwa branch of the western rift valley is well exposed. The actual fault-face is almost continuously visible for a hundred miles as a nearly straight rock-wall two hundred feet or more in height, over which every river makes a waterfall to the old lake-bed below.

Apparatus for Microradiography.—M. A. Dauvillier has described recently (*J. Physique*, June) an apparatus for microradiography which is in a sense a first step to the extension of the magnifying power of a microscope through substitution of X-rays for light. It makes use of the differential penetration of soft X-rays through different elements. The X-rays, generated at about 5 kilovolts in a hot filament tube, fall on a thin section of the tissue to be studied, attached to a photographic plate. Oxygen is decidedly more opaque to these rays than carbon, whilst they are absorbed practically completely by a small quantity of sulphur, so the underlying photographic emulsion takes a record of the elementary composition of the tissue which is practically independent of the exact nature of the compounds in the latter. After exposure, the tissue is removed, the plate intensified, and the image enlarged. By using special finely grained plates, of the type devised by Lippmann for colour photography, magnifications of several hundred diameters are practicable. One is reproduced of a section of elder pith (×600) with remarkably delicate detail. The range of possible applications of this method appears very wide; the technique is not unduly involved and easily within the resources of most physical laboratories.

Raman Spectrum of Hydrogen.—An account of the scattering of light from compressed hydrogen, much fuller than any previous work of this type, has been published by S. Bhagavantam in the issue of the *Indian Journal of Physics* for May. The aim of the experiments was to extend those of Rasetti and of McLennan, and in particular to compare the observed details of the intensities and polarisation with the quantum theory of the effect due to Manneback. Judging from the spectra and microphotometer traces reproduced, the work has been performed with great care. The main body of results actually affords a quantitative verification of the Manneback theory, but there is a striking disagreement in certain details of the polarisation, which it is again suggested can only be adequately taken account of by attributing an intrinsic spin to the light quantum.

Compounds of Inert Gases.—Whilst it is probable that the inert gases of the argon group are incapable

of forming stable chemical compounds, the long-established existence of a band spectrum which can only be attributed to the molecule He_2 shows that this gas at least can enter into transitory combinations. In the first July number of the *Physical Review*, H. Kuhn and O. Oldenberg discuss the spectrum which appears round the mercury resonance line at 2537 A. when this is excited by fluorescence in the presence of a large amount of rare gas. This consists of a general broadening of the line in both directions, the broadening showing evidence of structure, and it appears that it must be attributed to the formation of a short-lived compound between the mercury and inert gas. Apparently spatial quantisation of the pair of atoms takes place on their mutual approach. The phenomenon is not confined to mercury, similar spectra being observed with thallium, and some other metallic vapours, in the inert gases. The general correctness of this explanation of the spectra is born out by the occurrence of similar structures with dense alkali vapours, due presumably to the formation of almost unstable diatomic alkali molecules in which the binding forces are in the nature of polarisations.

Treatment of Gastric and Duodenal Ulcer.—Besides the constitutional factor, these ulcers have two causes, the first being the diminished resistive power due to a circumscribed lesion of the gastric or duodenal wall, and the second the action, continually renewed, of the normal gastric juice. The methods employed for treating such ulcers are discussed by Dr. Bazzano, of the University of Milan, in a communication published in the *Rendiconti* of the Reale Istituto Lombardo di Scienze e Lettere for 1932 (vol. 65, parts 6-10). It is argued that a rational cure involves the excitation of the defensive powers of the gastric wall and the creation of surroundings favourable to cicatrixation by modifying the gastric secretion, supported by almost normal conditions of general nutrition and by repose of the patient. These considerations, in conjunction with the results of laboratory experiments showing the marked anti-peptic properties of sodium benzoate, indicated that curative effects might be expected from the administration of this salt. A number of patients were accordingly treated with daily doses of 2 c.c. of a 25 per cent solution of sodium benzoate in sterilised distilled water, applied either hypodermically or intravenously. A few injections (in either way) sufficed to produce appreciable improvement in the symptoms, and complete cures were effected after more or less prolonged treatment. Subsequent examination (after some months) of several of the twenty-four cases treated by this means failed to reveal any disturbance of the digestive apparatus.

Astronomical Topics

Total Solar Eclipse of Aug. 31.—Unfortunately, clouds obscured the eclipse for many of the observers. A telegram to the *Times* from Dr. J. Jackson at Parent reports that the clouds were less thick early in totality, and some useful coronal photographs may result from exposures with the long-focus instrument; but it is feared that the photographs with the slit-spectrographs are failures. Prof. F. J. M. Stratton at Magog has cabled to NATURE: "Cloudy, no success"; and Prof. H. Dingle at Montreal says: "No observations possible at McGill University, Montreal. Sky covered with clouds throughout eclipse."

Similar reports were received from Conway (New Hampshire) and from Derby (Vermont), also from the Mount Wilson expedition; but Dr. J. H. Moore expressed the hope that some results might be obtained from the photographs of the Lick Observatory expedition (*Times*, Sept. 1). There are better reports from Louiseville, 50 miles north of Montreal, where the sky was clear. Eight photographs of the corona were obtained with an 8-inch camera; the shadow bands were well observed, also the effect of the eclipse on the barometer, thermometer, and electrical potential. Prof. Andrew Thomson, of the Canadian Meteorological Service, who has observed several eclipses, noted that the shape of the corona was more pointed and less evenly arranged than in the eclipses of 1918 and 1919. Prof. N. Hirayama states that the expedition from Kyoto obtained a perfect picture of the corona, and colour photographs of every part of its spectrum, which show a new line (*Times*, Sept. 2).

New Minor Planet.—Another minor planet of short period has been found; it is given the designation 1932 *PB*, as the first observation reported to the Berlin Rechen Institut was made on Aug. 4 by Prof. G. Neujmin at Simeis, the magnitude being 12·7. But R.I. Circular No. 646 reports that Prof. G. van Biesbroeck had already detected it on a plate taken at Yerkes on July 30. Dr. A. Kahrstedt has deduced elliptical elements from four Yerkes observations; these indicate a daily mean motion of 1754″, and a period of 2·023 years. The only known minor planets with shorter periods are Eros (1·76 years) and the Reinmuth planet, 1932 *HA* (about 1·8 years). Hence *PB* should be followed as long as possible; Dr. Kahrstedt gives the following ephemeris for 0^h:

	R.A.	S. Decl.
Sept. 10	$20^h\ 51{\cdot}7^m$	18° 38′
18	20 58·6	18 35
26	21 7·8	18 20

The Perseid Meteors.—The August Perseids have been successfully observed this year by the regular workers in England. Mr. King has a useful series of observations extending from July 30 to Aug. 13, and similar work was done by Mr. Alcock (who recorded 479 meteors during this fortnight) and by Mr. Prentice. All three observers had clear skies through the period of maximum (Aug. 10–13): and with the assistance of other observers, notably Mr. Folkard and Mr. Lane Hall, there should be a large number of accordances, yielding heights, etc. Seven meteors were photographed on Aug. 11, one by Mr. Collinson at Orwell Park, three by Mr. Vogel at Hampstead, and three by Mr. Waters at Harrow. Various counts have been made in addition, including one from India by the vice-principal of the Nizam College, Hyderabad. It appears that the return of the stream was rather less than normal strength this year, especially in the early stages: other results remain to be worked out.

Recent Fireballs.—Several bright fireballs have been reported during the past month, an unusual number having occurred during daylight or twilight hours. The first, on Aug. 6 at 10 h. 20 m. G.M.A.T. (noon-to-noon), was widely observed from Cornwall to the Suffolk coast, and a true path will be obtainable. A twilight fireball was recorded from East Anglia in twilight on Aug. 8 at 8 h. 20 m. G.M.A.T., and a preliminary path by Mr. King indicates heights of 43 to 16 miles. Two further twilight fireballs were recorded, on Aug. 10 at 8 h. 25 m. and Aug. 14 at 8 h. 20 m.; and, by Prof. W. J. Jones, of University College, Cardiff, a daylight fireball over the north of Scotland on Aug. 20 at 7 h. 54 m. True paths of the Aug. 10 and 20 objects may be obtainable. A further fireball is reported from Cornwall on Aug. 23.

The New Botanical Building at the University of Toronto

THE University of Toronto owes much to the able and wise administration of the retiring president, Sir Robert Falconer: by the part he played in securing adequate provision for teaching and research in botany he has earned the gratitude of all who are interested in that branch of biology. One of his last acts in Commencement Week of this year was to assist at the formal opening of the new Botanical Department on June 8. After an informal luncheon given to the visiting botanists, the Chancellor of the University, Sir William Mulock; the Prime Minister of Ontario, Mr. G. S. Henry; the President, Sir Robert Falconer; his successor, the Rev. Dr. Cody, chairman of the Board of Governors, and others, walked in procession to the new building, which was opened by the Prime Minister.

Fig. 1.—Front view, showing the main entrance of the new botanical buildings of the University of Toronto.

Photo] [Peake and Whittingham, Toronto

Fig. 2.—The range of glass-houses behind a wing of the new botanical building, University of Toronto.

The Prime Minister paid a tribute to the architects, Messrs. Mathers and Haldenby, both of whom are graduates of the University, and stated that all the material used in construction was Canadian. In handing over the building to the chairman of the Governors, he said that it should be regarded as an expression of the interest of the Government, the legislature, and the people of the province in the cause of higher education.

Dr. Cody, in accepting the building, spoke of botany as one of the first subjects taught in the early days, in 1843, when the University was known as King's College. Botany was then one of several sciences for which the professor of experimental philosophy was responsible. In 1853, when King's College was promoted to university status, the Rev. William Hincks was appointed professor of natural history: one of the applicants for the chair was Thomas Henry Huxley. The present head of the department, Prof. R. B. Thomson, was appointed to that position in 1928.

Dr. Cody gave a brief account of the building, which he described as one of the most attractive in the University group. It was erected at an inclusive cost of 517,000 dollars on a site at the entrance to Queen's Park: there is a well-lighted ground-floor with three floors above arranged round a central court. The inside walls are lined with bare brick: there is about an acre of floorspace. On the ground-floor and the floor above, provision is made for plant pathology and plant physiology under Dr. D. L. Bailey and Dr. G. H. Duff; on the second floor are laboratories for morphology and the anatomy of flowering plants under the personal charge of Prof. Thomson: mycology under Prof. H. S. Jackson, seed laboratories under Dr. H. B. Sifton, and the herbarium are on the third floor. Ample provision is made for

research rooms. Adjoining the building is a range of glass-houses. Dr. Cody added that about a thousand undergraduates would be accommodated in the new laboratories.

Sir Robert Falconer invited five of the botanical delegates to give short addresses: Prof. A. C. Seward of the University of Cambridge; Prof. K. M. Wiegand of Cornell University; Dr. H. T. Güssow, the Dominion botanist; Prof. Marie-Victorin of the University of Montreal; and Prof. F. E. Lloyd of McGill University. On the following day the honorary degree of Sc.D. was conferred upon Prof. A. C. Seward.

Plant Products of the British Empire

FROM prehistoric times, man has depended to a considerable extent upon plant products, from various economic points of view. Some such products are necessities and others are luxuries. Some which were primarily luxuries have now become, with the great changes in human civilisation and habit, quite essential to human needs. These constant changes and new developments in human needs as regards the vegetable kingdom formed the basis of Sir Arthur Hill's evening discourse delivered at the York meeting of the British Association on Sept. 2, entitled "Plant Products of the Empire in Relation to Human Needs".

The economic botanist seeks to satisfy our human needs, both natural and artificial, and with the tremendous modern developments in human life and habit, his work has become of primary importance. With such a widely scattered Empire, Great Britain is able to supply itself very largely from its own colonies and dominions. Two great 'cravings' of to-day—newspapers and motor cars—are resulting in the destruction of the magnificent forests of Canada and Newfoundland and the extensive plantations of *Hevea brasiliensis*, the latex of which supplies the raw rubber, in various parts of the Empire.

Fortunately for Great Britain, it is possible, to a great extent within the Empire, to meet the growing demand for various plant products, such as oils and fats, cereals, fruit, animal foods, spices and condiments, beverages, gums and resins, drugs, tobacco, clothing, timber, etc. Certain other industries are fast disappearing, owing to changes in present-day methods and fashions. For example, indigo, camphor, and vanilla are giving place to synthetic substitutes, and cotton and flax have a strong competition in artificial silk. Another group of the Empire's plant resources, often lost sight of, because it does not appear on the world's markets, is native products used chiefly by those who cultivate them. The importance of such Empire products is scarcely ever realised until such times as famine and crop failure.

During the course of his address, Sir Arthur indicated the original homes, throughout the British Empire, of some of the economic plants. Efforts are still being made to find plants of economic value which can be grown within the Empire, with the ultimate aim of making the Empire self-supporting so far as possible. With the large increase in cultivated areas, complications such as plant diseases have been set up, necessitating the creation of an army of specialists—plant pathologists, entomologists, physiologists, etc. Rust on wheat in Canada, for example, is estimated to destroy annually £5,000,000 worth of wheat. Every year, in the British Empire alone, insects destroy enough food to supply forty-five million people.

The band of scientific workers attached to the various departments of plant economic and agricultural research throughout the Dominions and Colonies seems a rather formidable one, yet their numbers and cost of maintenance are negligible compared with the toll levied by the diseases they are attempting to overcome.

Since its inception, the Empire Marketing Board has given invaluable help in the war against plant diseases, in research on plant storage, etc., and it has spent £1,235,000 in grants for research. In many cases, too, research is supported financially by firms which depend upon the various plant products for their raw materials. For example, Messrs. Rowntree, Cadbury, and Fry are supporting the research work on cacao now being carried out at Trinidad.

The scientific problems confronting the Empire in connexion with our supplies of plant products offer a fitting outlet both for private and public munificence, and those who come forward to support the new culture of scientific research and its application to human needs will realise that they are not merely satisfying a noble enthusiasm, but are also fulfilling one of the pressing needs of the Empire.

Electricity Supply in New York

NO city in the world owes more to the advance of engineering than New York, within the boundaries of which are to be found some of the finest bridges, tunnels, subways, high buildings, and power stations ever constructed. The progress of these great undertakings is dealt with from time to time in our own technical journals, and in *Engineering* for May 13, 27, and June 17 is given a well-illustrated account of the present position of the electrical supply schemes in the city.

Fifty years have elapsed since Edison erected the first public electric supply station in Pearl Street, and that was but the beginning of the great interconnected stations by which New York and the suburbs are served to-day. The greater part of New York is now served by the Consolidated Gas Company, which in 1928 obtained control of five separate undertakings serving an area of 550 square miles and a population of 6,017,702. In 1927, the last complete year that the five companies operated as separate concerns, the total output was 4,000,000,000 kwh. and the plant installed had a total capacity of 1,400,000 kw. The capacity of the plant by September 1930 had been increased to 2,009,700 kw., and plans are now in hand for a further increase in plant designed to meet a demand which it is estimated will by 1940 be three times as great as that in 1927.

At present, power is generated in seven stations, of which Hell Gate Station has plant of 605,000 kw. and Hudson Avenue Station plant of 560,000 kw. At Pearl Street Station direct current was generated and distributed, but to-day all current is generated by alternators, the frequency being either 25 cycles or 60 cycles, frequency changers being installed so that current is available from any station for any part of the system. Interconnexion is to be carried still further by the erection of a transmission line to Schenectady, thus enabling power to be brought to New York from Niagara.

A new problem in the economical distribution of electricity arose with the erection in New York of very high buildings, and in *Engineering* for June 17

an account is given of the methods of distribution in the Chrysler Building, 1047 ft. high, and the Empire State Building, 1300 ft. high. Experience with the Irving Trust Company Building had shown that a saving could be effected by installing transformers not only in the basements but also on more than one floor of buildings more than forty stories high. In the Chrysler Buildings the high-tension feeders, therefore, are carried direct to substations with transformers on the thirtieth, sixtieth, and seventy-fourth floors, while in the Empire State Building there are substations on the forty-first and eighty-fourth floors in addition to that in the sub-basement.

The Empire State Building covers an area 420 ft. by 200 ft., and its 86 floors can house some 40,000 persons, or as many as a fair-sized town. Illumination is provided on a liberal scale, and the estimated lighting load is 6000 kw., while for the lifts, fans, pumps, and other plant electric motors of a total of 9600 horse power are installed. The substations are fire-proof brick structures and each contains four or five 600 kw., 13,800/200-volt transformers. The main vertical cables are rated for a pressure of 15 kw. and are about 3 in. in diameter with an approximate weight of 6 lb. a foot, and in the article referred to is an interesting account of the methods adopted for placing them in position and securing them.

University and Educational Intelligence

BIRMINGHAM.—Under the will of the late Mr. James Gittins Chidlaw, of Edgbaston, a member of the Court of Governors, a sum of more than £10,000 will be put at the disposal of the Council of the University for the endowment of scholarships.

MR. E. J. W. BARRINGTON of Oriel College, Oxford, has been appointed lecturer in zoology, and Dr. F. C. Champion of St. John's College, Cambridge, assistant lecturer in physics, at University College, Nottingham.

THE Council of the Institution of Naval Architects has awarded the Martel scholarship in naval architecture (1932), valued at £130 per annum for three years at the University of Liverpool, to Mr. H. G. Herbert, of Sheerness Dockyard, and the Earl of Durham prize to Mr. N. H. Young, of Devonport Dockyard.

A SURVEY of industrial education in the United States of America has been published by the Office of Education, Washington, as *Bulletin* No. 30, 1931. Among recent developments is noted the more general recognition of the importance of maintaining close contact and co-operation between the school officials and industrial firms. Committees composed of representatives of employers and employees have been especially valuable in selecting the courses to be included in the training programme, in securing properly qualified teachers and adequate equipment, and in the organisation of instruction so as best to meet the needs of industry. There is yet lacking, however, a sufficiently high degree of correlation between the courses provided in the schools of a given locality and the needs of the dominant local industries. Increasingly the public schools accept responsibility for vocational guidance with the view of placing their pupils in suitable occupations, and increasing interest is manifest in occupational information courses. Progressive specialisation in industries has led to corresponding specialisation in the schools, and the number of separate courses has been further increased by the inclusion of training for a number of semi-skilled occupations for which a short period of school instruction is now held to be worth while. Evening school work has received more attention, because money spent on training persons already employed yields a more certain and immediate return than pre-employment training. The increasing use of electricity on the farm and in the home is stimulating the development, even in small schools, of courses in simple electric wiring, the operation and maintenance of electrical appliances, and other instruction in applied electricity. Similarly, a belief that aviation will constitute a principal method of transportation in the future is leading to the provision in secondary schools of courses in model aircraft building, etc.

Calendar of Geographical Exploration

Sept. 13, 1898.—Capt. M. S. Wellby's Explorations

Capt. M. S. Wellby left Berbera on the north coast of British Somaliland, penetrated to the Omo River, and thus entered Lake Rudolf. He then turned north-west and explored part of the course of the Sobat River. In 1896, Wellby and Lieut. Malcolm had carried out a journey in Tibet, crossing the country from Leh to Kuku Nor, afterwards following the Hwang-ho and reaching Peking. This journey filled in many previously blank spaces on the map of Tibet.

Sept. 14, 1927.—The *Norvegia* Expeditions to the Antarctic

The *Norvegia*, a vessel fitted out by Consul Christensen, left Sandefjord harbour to begin that series of antarctic researches which has added so much to scientific and especially oceanographical knowledge of the region. Various scientific workers and aeronauts have taken part in the *Norvegia's* work, and, under the leadership of H. Rüser-Larsen, Queen Maud Land, Ragnhild Land, and Princess Martha Land were discovered. Early in 1931 the *Norvegia* completed the circumnavigation of the antarctic continent. The Russian explorer, Bellingshausen, in 1819-21, had previously made the circumnavigation of the continent in high latitudes, while Cook and Biscoe had made similar journeys in somewhat less high latitudes.

Sept. 15, 1587.—Davis Strait

John Davis arrived at Dartmouth after his third arctic voyage, during which he had pushed through the strait named after him into Baffin's Bay and coasted the west of Greenland to 73° N. On his first voyage, in 1585, Davis had sighted southern Greenland, which he called the Land of Desolation, had crossed Davis Strait, explored part of the Canadian archipelago, and had penetrated some distance into Cumberland Sound. On his second voyage, in 1586, he again reached the north-east coast of America. His voyages pointed the way to the true north-west passage, though it was not given him to reach it. He added much to the knowledge of the coasts of Greenland and north-east America. In 1591 he accompanied Cavendish on his voyage with the object of "searching that north-west discovery upon the back parts of America". After the rest of Cavendish's party had turned back, Davis continued the journey and discovered the Falkland Islands. He was killed by Japanese pirates when off Sumatra in 1605. Davis is also entitled to fame as an inventor; his back staff and double quadrant held the field long after Hadley's reflecting quadrant had been introduced.

Sept. 17, 1776.—Basin of the Colorado River

Father Garcés, a Franciscan missionary, reached Bac. He had set out in 1775 from the Yuma country, travelled from the mouth of the Colorado to Mojave,

and opened a new route across to San Gabriel. Thence he made a trip northward to the Tulare valley, returned to Mojave, and proceeded eastward to the Moqui country. Garcés had made many previous journeys of exploration, including a descent of the Rio Gila to the Colorado in 1771. Garcés was murdered by the Yuma Indians in a subsequent attempt to found a mission amongst them.

Sept. 17, 1822.—Weddell in the Antarctic

James Weddell in the *Jane*, accompanied by the *Beaufoy*, left on a voyage which combined whaling with discovery. Weddell had previously, in the *Jane*, visited the South Shetlands, discovered in 1819 by William Smith, and had carried out some surveys there. On this voyage he proved that the Aurora Islands, which were supposed to lie between the Falklands and South Georgia, did not exist. Weddell explored the sea which now bears his name, and reached 74° 15′ S. He brought back with him a sea leopard (*Hydrurga leptonyx*); Weddell's seal (*Leptonychotes Weddelli*) is named after its discoverer.

Societies and Academies

PARIS

Academy of Sciences, July 25 (vol. 195, pp. 293-344).—**Robert Bourgeois**: Obituary notice of Antonio Luiz de Teffé, *correspondant* for the Section of Geography and Navigation.—**Émile Guyénot** and **A. Naville**: Reduction of chromosomes in the female *Drosophila* and the theory of crossing over.—**M. Syptak**: The hypercircumferences and hyperhelixes in Euclidian spaces of p dimensions.—**Maurice Roy**: The definition and laws of the sudden variation of section in gaseous jets.—**Edmond Brun** and **Pierre Vernotte**: The measurement of the coefficient of thermal exchange between a solid wall and a current of gas.—**Henri Chaumat** and **Edouard Lefrand**: An electric motor utilising the kinetic energy of gaseous ions. A description of the construction and working of an 'ionic turbine'.—**René Audubert**: The calculation of the average radius of the granules of a dispersed system. If, at high dilutions, the electrokinetic potential be considered as obeying the Debye-Hückel theory, then the average radius of the granules of a dispersed system can be calculated by means of relations deduced from this theory.—**Radu Titeica**: The vibration spectra of some polyatomic molecules. The results of measurements of the infra-red absorption bands of formaldehyde and of acetone are given.—**Ny Tsi-Ze** and **Choong Shin-Piaw**: The absorption of light by ozone between 3050 A. and 3400 A. (the region of the Huggins bands).—**M. Bourguel**: Double conjugated linkages.—**Mlle. B. Grédy**: The application of Raman spectrography to the study of the rhodinol-citronnellol isomerism. These experiments do not confirm the formula of citronnellol suggested by Verley (α form): rhodinol contains three isomeric alcohols.—**D. Skobelzyn**: The mechanism of the phenomena of the ultra-penetrating radiation (cosmic rays).—**S. Rosenblum**: The fine structure of the magnetic spectrum of the α-rays of radium.—**H. Muraour** and **G. Aunis**: Study of the velocity of combustion, at a low temperature, of colloidal powders.—**Victor Lombard** and **Charles Eichner**: Researches on the conditions of optimum diffusion of hydrogen through palladium.—**A. Cochet** and **J. Houdin**.—The phosphates of urea and of guanylurea.—**Henri Fournier**: The results furnished by stamping tests and their relation with extension tests.—**Ch. Bedel**: The density of ferrosilicons. Thirteen alloys were prepared, ranging from 0 to 100 per cent iron. Indication of density variations were observed when the composition of the alloys corresponded to Fe_2Si and FeSi.—**Ed. Chauvenet** and **Avrard**: The determination of barium in iron ores. The iron is removed as ferric chloride by heating to 900°-930° C. in the vapour of carbon tetrachloride.—**P. Bugnon** and **A. Parrot**: The morphological value of the cotyledon in monocotyledonous umbellifers.—**Mme. Liou (Tchang-Tcheng-Houa)**: Various peculiarities of the development of the egg of *Bombyx mori* under the influence of bivoltinising agents.—**Ch. Dhéré**: The fluorescence of phyllærythrin and the structure of its fluorescence spectra.—**J.-E. Abelous** and **R. Argaud**: The formation of adrenaline in the suprarenal gland. The results of the experiments described are inconsistent with the view that the medullary substance is exclusively concerned with the production of adrenaline.—**Mme. Andrée Roche** and **Jean Roche**: The participation of the hexosephosphoric acid in the glycolysis of the blood.—**Aynaud**, **Peyron**, and **Falchetti**: Cancer of the lung in sheep and its etiological connexion with parasitic and infectious lesions.

CAPE TOWN

Royal Society of South Africa, March 16.—**W. A. Jolly**: The living organism (Presidential Address). If we are ever to attain to self-knowledge, to explain ourselves, and to determine our place in Nature and our relation to the world around, it is to advance in biology that we must trust. All that we know of the universe is due to physiological changes of some kind. In the living organism, regarded as a whole, we have a phenomenon the unity and fundamental nature of which are as essential as any of the concepts of physics. Psychology, studied by subjective methods, working in collaboration with physiology, has an important part to play in our final achievement of self-knowledge. The address concluded with an account of the methods and difficulties of modern physiological research, with special reference to electro-physiology and the time-relations of the simple reflex.—**F. Kirchheimer**: On pollen from the Upper Cretaceous dysodil of Banke, Namaqualand. These pollen forms, probably of Upper Cretaceous age, do not in the least agree with the present-day flora of the area. This serves to show, in conjunction with the character of the megascopic plant remains, that the ecological character of the area at the time of formation of the deposits was widely different from that of to-day.—**E. Reuning**: The composition of the deeper sediments of the pipe at Banke, Namaqualand, and their relation to kimberlite. The various rocks known found in the neighbourhood—granite, dolerite, and Karroo sediments—can have contributed but little to the composition of the dysodil, which is apparently the product of the infilling of the pipe by finest mud obtained from the weathering of ejected kimberlite material lying on the granite in the neighbourhood of the pipe.—**S. H. Haughton**: On some South African fossil Proboscidea. New proboscidean remains attributed to the genera *Archidiskodon* and *Pilgrimia*. There is evidence of considerable dental variability within the confines of a single living race of African elephant. The geology of the various gravels of the Vaal River area is critically examined; the possibility that the gravels of the so-called 'Middle Terrace' and the 'River-bed Gravels' may be contemporaneous is discussed.

GENEVA

Society of Physics and Natural History, May 19.—**R. Cherbuliez** and **A. Rilliet**: On methylcodeine. The methylation of the hydroxyl group of codeine is made difficult by the presence of the basic tertiary function,

the latter being more easily methylated than the hydroxyl group. This difficulty is got over by transforming the codeine into its chlorbenzylate. After methylation of the alcohol group of this quaternary derivative, the original amino group is regenerated by reduction with sodium amalgam.—**P. Rossier**: (1) The relation between the abscissæ of the extremities of a solar spectrogram (2). The author gives a better approximation, because based on more complete data, of the constants of an astrophysical formula.—(2) On the spectral type of some stars. The *K* line shows an abnormal width on some spectrograms of stars of the type A_0, obtained at the Geneva Observatory. On the majority of these negatives a spectrophotometric study based on the position of the extremities of the spectrograms appears to indicate a spectral type more advanced than A_0.—**H. Lagotala**: The geology of the mining region of Renéville, French Equatorial Africa. The author gives an interpretation of the facts observed in numerous excavations and borings. The general characteristic of the tectonics of this region is given by a series of faults, between which the compartments have had displacements in varying directions. As a result, there are sudden interruptions of the outcrops.—**J. Buffle** and **J. Corbaz**: Researches on the chlorination of α-nitronaphthalene. This operation differs substantially from the usual process of chlorination. Although without practical value, it has a theoretical interest, as it leads to a knowledge of the nature of the various intermediate compounds preceding the final products, α-chlornaphthalene and polychlornaphthalene.—**L. Reverdin**: The fauna of the middle and later neolithic of the station of Auvernier, Neuchâtel. Passing from the middle neolithic to the later neolithic, it is found that the percentage of bones belonging to domestic species increases from 49·2 to 90·4. The percentages of individuals increases from 46·7 to 72·4. For this station, the diminution in the utilisation of wild animals is very clear, but, starting with the middle neolithic only, the mean percentage of individuals belonging to domestic species was about seventy for the lower neolithic.—**P. Dive**: The risks of extrapolation in the field of geophysics. The author shows by calculation that the contradiction is only apparent, when the rigidity of the globe, such as results from the transmission of seismic movements, is opposed to the viscosity that it is necessary to attribute to the sima on which the continental masses are displaced. This contradiction arises from the fact that the experimental data of the laboratory are applied where the determining factors are magnitudes much too small compared with those factors which act in the mass of the globe. Reduced to the 'human scale' the globe appears as a body 300 times less viscous than water.—**R. Wavre**: The extension of a formula of H. Bruns. The author extends the formula which Bruns has made known for equilibrium figures to the case of a perfect fluid endowed with any movement.

MELBOURNE

Royal Society of Victoria, July 14.—**D. E. Thomas** and **R. A. Keble**: A revision of the subdivision of the Upper Ordovician and Silurian rocks of Victoria. The authors discuss the subdivisions of the two formations and propose a revision based on new and additional graptolite evidence.—**Walter J. Parr**: Notes on Australian and New Zealand Foraminifera (2). The genus *Pavonina* and its relationships. Two species of *Pavonina*, *P. flabelliformis* d'Orbigny and *P. triformis*, sp. nov., from the Tertiary of Victoria, are described and figured. *P. triformis* differs from previously known species of *Pavonina* in having the earliest chambers triserially arranged, and so resembles the genus *Reussia*. Evidence of the relationship of *P. triformis* and *P. flabelliformis* is produced by the author, who considers that the genus should consequently be placed in the family Buliminidæ, near the genera *Reussia* and *Chrysalidinella*.

ROME

Royal National Academy of the Lincei, March 6.—**L. Cambi**, **L. Szegö**, and **A. Cagnasso**: Magnetic behaviour of complex compounds. (5) Ferric dibutyldithiocarbamates. The results obtained with six isomeric compounds are analogous to those furnished by the dipropyl derivatives. Only the *NN-n*-butylisobutyl salt follows the Weiss-Curie law, the rest obeying a more complex law. This anomalous behaviour appears general in the dialkyldithiocarbamates and is shown also by ferric xanthates.—**A. Stella**: An interesting ferro-titaniferous deposit in the Arabian Desert. This mountainous deposit, known as Abu Galga, was found on ascending for about 20 km. the Madi Ranga valley, which opens out on to the Red Sea. When separated from the gangue the mineral contains about forty per cent of TiO_2.—**G. Andreoli**: Reciprocal pairs of V_2: law of the duality of linear and tangential metrics, of parallelism and metrism. (2) Formation and properties of the pair of reciprocal varieties.—**Patrick Du Val**: Observations on the surfaces of one kind which are not bases for a system of quadrics.—**M. Kourensky**: Integration of the equations to partial derivatives of the second order with two functions of two independent variables.—**L. Sona**: Orthobaric surfaces of a body.—**L. Campedelli**: Double planes with curve of branching of the tenth order.—**M. Crenna**: Deformable Ribaucour congruences (2).—**Giulio Supino**: Clebsch's problem.—**G. Krall**: The asymptotic effects of the tides on the motion of celestial bodies. (2) Problem of three bodies.—**N. Moisseiev**: The law of resistance to the motion of bodies in a pulverulent medium. (2) Special noteworthy cases.—**G. Agamennone**: Ultra-powerful horizontal pendulum with mechanical registration.—**G. B. Bonino** and **P. Cella**: The Raman spectrum of quinoline and manifestations of the carbon-nitrogen linking. Six lines have previously been observed in the Raman spectrum of quinoline, but the authors' investigation reveals nine lines. Those at 3054 (cm.$^{-1}$) and 1571 correspond with the aromatic C – H grouping and with the aromatic double linking respectively. An intense line between 1370 and 1380 must be attributed to the condensed double nucleus of the quinoline molecule; it appears very intensely in the spectrum of naphthalene, but is very weak in that of pyridine. Similar considerations apply to the lines 1142 and 764, which occur with equal intensity in the naphthalene spectrum. The line 1433, which lies within the zone (1200-1800) of the Raman spectrum assigned by Kohlrausch to double bonds, is ascribed to the double linkage between carbon and nitrogen, and is, indeed, shown by all compounds which contain a C : N group but no CH_2 group in the molecule.—**G. Natta** and **M. Baccaredda**: Mineral antimoniates of calcium (atopite, romeite, calciferous antimony ochre). Descriptions are given of various antimony ochres containing combined calcium which correspond with the formula 2 – 3CaO, $2Sb_2O_5$, 6 – $8H_2O$. They exhibit cubic lattices, unit cells of side 10·25 – 10·26 A., and lattice structures analogous to that of atopite. Romeite gives an X-ray (powder method) appearance similar to that of atopite and, like the latter, has the value 10·26 A. for the side of the unit cell and belongs to the space group O_h^7 or O_4.—**Z. Jolles**: Diazo-resins (2). As would be expected, phenylazoxycarbonamide, which is transformed into the normal diazo-hydrate by the action of alkali, gives a resin identical with that obtained directly from

diazotised aniline. Moreover, nitrosoacetanilide undergoes resinification when left in contact with alkali for some hours, yielding a product which is darker than, but of similar composition to, that derived from aniline. The passage of the nitrosoacetanilide to normal diazo-hydrate possibly takes place by way of an intermediate additive compound.—**E. Moltoni**: A selection of the birds reported by the Desio mission to the Libyan Desert.—**G. Lakhovsky**: Cosmic waves and cellular oscillations. The experiments described by Rivera (1930) indicated that the observed excitation of cellular division cannot be ascribed to cosmic waves, which have a slightly depressive influence on germination. The results of these experiments confirm the author's theories, according to which variation in cosmic waves causes oscillatory dis-equilibrium of cells and hence disease and death.

VIENNA

Academy of Sciences, May 12.—**G. Gorbach** and **H. Pick**: Ultra-violet inactivation of sucrase in its dependency on the hydrogen ion concentration and ozone. With the purest possible sucrase solutions, the influence of the prevailing hydrogen ion concentration on inactivation by ultra-violet rays is vanishingly small. This inactivation cannot be ascribed to the ozone formed, but results from direct absorption of the short-wave energy either by the sucrase itself or by substances accompanying it.—**G. Gorbach** and **D. Kimovec**: After-inactivation of irradiated sucrase solutions, and the influence of added tryptophane and yeast-gum. Sucrase solutions which have been subjected for at least ten minutes to ultra-violet radiation, afterwards become inactivated; this after-inactivation is accelerated somewhat by addition of tryptophane or yeast-gum after the irradiation. If the sucrase solution is exposed to the rays for less than ten minutes, the enzyme retains part of its activity.—**G. Gorbach** and **H. Güntner**: Yeast lipase. Lipase from brewery or pure-cultured beer-yeast exerts its optimum activity at *p*H 6·6-6·8 and at 30° C. In general, pressed yeasts are richer in lipase than beer-yeasts, and pure-cultured yeasts than brewery process yeasts. Artificial fatting of yeasts causes marked increase in their lipase contents.—**Richard Weiss** and **Ernest Knapp**: Triphenylmethanes with their benzene nuclei linked together. (7) Methylenediphenylenephenylmethane ketone.—**J. Rosenhagen**: Observations on the brightness and light-change of the planet Eros. The fact that the phase coefficient, the normal brightness, and the amplitude of the light-change of Eros are subject to wide variations is attributed not so much to physical changes as to a peculiar shape of the planet and to alternation in the position of its axis of rotation with regard to the earth. Other elements, such as precession phenomena, deformation of the body of the planet, etc., also produce secondary effects.—**Otto Porsch**: An interesting case of convergence of blossom by adaptation.—**Emil Heinricher**: Further investigations on the descendants of *Primula kewensis*.

May 27.—**Ernst Beutel** and **Arthur Kutzelnigg**: Luminescence analysis. (4) Fluorescence of zinc oxide.—**Bruno Finzi**: Results of a zoological expedition to Morocco in 1930. (5) Ants.—**Josef A. Priebsch** and **Rudolf Steinmaurer**: A year's observations of the cosmic ultra-radiation on the Sonnblick peak (3106 metres). Determinations of the ultra-radiation on this peak gave, in a slightly open iron sheath, the value 8·00 *I* (ion-pairs per second per c.c. of air at 760 mm. and 18° C.) and, in the closed sheath, 6·13 *I*, reduced to 520·5 mm., which is the mean barometric pressure on the Sonnblick. During the winter months low, and during the summer months high, values for the radiation intensity were observed, the minimum and maximum appearing to correspond respectively with the lowest and highest position of the sun. In the course followed by the variations, and in the yearly deviations (4 per cent), the results are in agreement with those obtained by Steinke in Königsberg. The intensity of the radiation is apparently not related to either the degree of cloudiness, amount of precipitation, or direction of the wind.

Forthcoming Events

Congresses

SEPT. 10–18

INTERNATIONAL CONGRESS OF THE HISTORY OF MEDICINE (Ninth Congress). To be held at Bucharest.

SEPT. 12–15

IRON AND STEEL INSTITUTE AND INSTITUTE OF METALS. Joint Autumn Meeting at the Institution of Civil Engineers, Great George Street, S.W.1; and the Institution of Mechanical Engineers, Storey's Gate, S.W.1.

Monday, Sept. 12.

Dr. H. J. Gough: "Corrosion Fatigue in Metals" (Annual Autumn Lecture), at 8 P.M.

SEPT. 12–15

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN (Annual Conference). To be held at Aberdeen. Chairman's Address on Sept. 13, at 10 A.M.

Official Publications Received

British

Transactions of the Institute of Marine Engineers, Incorporated. Session 1932, Vol. 44, No. 6, July. Pp. 271-322+xxxiv. (London.)

Bulletin of the Department of Zoology, Panjab University. Vol. 1: Fauna of Lahore. 3: Preliminary Notes on the Life-History of the Firefly *Luciola gorhami* Rits, and Cytology of the Light Organs. By Dev Raj Mehta. Pp. 101-118+plates 9-10. (Lahore.) 1.8 rupees.

Survey of India. Geodetic Triangulation. By Capt. G. Bomford. Pp. viii+109+87 plates. (Dehra Dun.) 2.8 rupees; 4s. 6d.

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1931. Pp. 36+8 plates. (Jamaica: Government Printing Office.)

Journal of the Chemical Society. July. Pp. iv+1905-2088+x. (London: Chemical Society.)

Ceylon. Part 4: Education, Science and Art (F). Administration Report of the Director of the Colombo Museum for 1931. By Dr. Joseph Pearson. Pp. F16+4 plates. (Colombo: Government Record Office.) 30 cents.

Transactions of the Optical Society. Vol. 33, 1931-32, No. 4. Pp. ii+137-188. (London.) 10s.

Journal of the Indian Institute of Science. Vol. 15A, Part 5: Bhadravarti Wood-Tar and its Utilization. By Y. K. Raghunatha Rao, B. Sanjiva Rao and H. E. Watson. Pp. 41-58. (Bangalore.) 1 rupee.

The International Union for the Scientific Investigation of Population Problems: its Foundation, Work, Statutes and Regulations. Pp. 28. (London: c/o Royal Geographical Society.)

Foreign

Memorias del Consejo Oceanográfico Ibero-Americano. Número 8: La corriente del Peru y sus límites norteños en condiciones normales y anormales. Por Prof. Gerhard Schott. Pp. 57+3 laminas. Número 9: El Instituto Español de Oceanografía y la labor que ha realizado. Por Prof. Rafael de Buen. Pp. 72+10 laminas. Número 10: Nuevas investigaciones gravimétricas sobre los mares. Por Guillermo Sans Huelin. Pp. 14+2 laminas. Número 11: Cooperación española a la Oceanografía. Por Prof. Rafael de Buen. Pp. 32. (Madrid.)

Egyptian University: Faculty of Science. Publication No. 1: The Food of Protozoa; a Reference Book for use in Studies of the Physiology, Ecology and Behaviour of the Protozoa. By H. Sandon. Pp. iii+187. (Cairo.) 20 piastres.

Proceedings of the Imperial Academy. Vol. 8, No. 6, June. Pp. xvii-xviii+217-278. (Tokyo.)

Préhistoire. Tome 1, Fascicule 1. Pp. iv+123+5 planches. (Paris: Ernst Leroux.) 125 francs.

U.S. Department of Agriculture. Miscellaneous Publication No. 120: A Digest of the Literature of Derris (Deguelia) Species used as Insecticides, 1747-1931. By R. C. Roark. Pp. 86. (Washington, D.C.: Government Printing Office.) 15 cents.

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1931. Pp. 14. (Batavia.)

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 9: The Cultivation and Manufacture of Tea in Ceylon and India. By E. A. Curtler. Pp. iii+94+5 plates. 1 dollar. Circular No. 3: The Cultivation of Allotments by Tamil Labourers. By J. N. Milsum. Pp. 12. 10 cents. (Kuala Lumpur.)

SATURDAY, SEPTEMBER 17, 1932

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Science in Social Problems

IT has continually been urged in these columns that an organised endeavour should be made to link up scientific knowledge with appropriate action in social, economic, and national affairs. Sir Alfred Ewing's presidential address to the British Association at York indicated the extent to which scientific workers are now concerned with the social consequences of their discoveries. At the present moment the disorganisation in the world's economic and distribution system, with the resultant widespread industrial depression and unemployment which has resulted from the advent of power production, is perhaps uppermost in our minds. The dangers which threaten civilisation through its failure to make a rightful use of the enormously increased productive powers with which mechanical science has endowed it, are by no means the only threat which the gap between scientific advance and moral or ethical development offers. The fourteen years which have passed since the War have, as yet, brought no check to the prostitution of scientific effort to destructive purposes. Far more destructive weapons are now available, and a repetition of the calamity of 1914 may well threaten the extinction of civilisation. As yet, however, neither scientific workers nor any other section of the community has succeeded in calling any real halt in armaments, or in inducing the Governments of the world to base their policies upon the obvious fact that the renunciation of war as an instrument of national policy is a fundamental condition of the security of civilisation.

These are major matters, but equally in lesser issues is it true that the enjoyment of the benefits of applied science involves the renunciation of deeply embedded habits and prejudices. The same forces which can minister so abundantly to our resources, our pleasures, our health, our enjoyment of life, can become a most serious public danger in the hands of careless, indifferent, or selfish individuals. The possibilities of the abuse of power increase with its magnitude in the same proportion as the possibilities of its beneficial use, but while use is dependent on knowledge, abuse is as possible in the hands of the ignorant and thoughtless as it is in those of the deliberately selfish or morally perverse.

The realisation of these conditions, coupled with the backward condition of the so-called social sciences, has already led many scientific workers and others to sound a warning note. Sir Alfred

Ewing's assertion that man was ethically unprepared for the great bounty of the engineer, that in the slow evolution of morals he was still unfit for the tremendous responsibility it entailed, and that the command of Nature had been put into his hands before he knew how to command himself, found support at the British Association meetings in the subsequent address of Prof. Miles Walker to the Engineering Section.

Prof. Miles Walker referred to the way in which vested interests blocked the way to improvement, and unintelligent control and stupid prejudice preserved the old evils, refusing to be convinced, long after science had shown the way to make things better for the people. The persistence of atmospheric pollution, mainly through domestic smoke, with the attendant loss of sunshine, and waste in dirt, health, and valuable by-products, the waste of heat and power, the paralysing influence of the middleman on the grid system —these are familiar examples of the way in which prejudice and selfishness react against the general welfare and prevent the utilisation of the benefits of applied science. Prof. Miles Walker proceeded, however, to emphasise the contribution which the engineer and man of science could make in economic and social matters, also towards the amelioration of the lot of mankind. Asserting that knowledge must form an essential qualification for executive office in the modern State, and was indeed the only sound basis for action, he suggested that in a small self-supporting State under the control of men of science it might thus be possible within a few years to demonstrate the high standard of life obtainable by modern organisation and modern methods. But as Sir Josiah Stamp remarked in a discussion in the Section of Agriculture dealing with the distribution and marketing of agricultural products, we need the moral rectitude of a Joseph, as well as his economic prudence, in planning under the conditions of to-day.

The direct outcome of the presidential address to the Engineering Section was a resolution passed by the Section expressing its conviction that the present world depression indicates that the machinery of government and finance is inadequate to deal with the vastly increased productive capacity of peoples brought about by the application of science, and the further opinion that the present economic position of Great Britain calls for far wider co-operation between the scientific community and the Government. The resolution urged the Government to invite the leading scientific institutions and societies to appoint in conference representatives to co-operate with the Government to formulate plans for dealing with the present problems facing the country.

The desire of the promoters of the resolution, however, to gain the assent of the whole of the British Association was disappointed, as when the resolution came before the Committee of Recommendations, it was turned down by a large majority. The resolution will accordingly not be passed on to the Council of the Association for adoption, although of course the Council could itself take independent action if it wished, without any suggestion from the Committee of Recommendations. It is perhaps not surprising to find that representatives of science present at the York meeting are not actively interested in the social consequences of scientific progress. Science is so specialised to-day that workers in any one branch of science are liable to have their attention so concentrated upon their own particular subjects that they see little of the field around them, and are unconcerned in its general activities or problems. The representation at the British Association meetings is still largely academic, and it may be hoped that, as the industrial element in the attendance increases, the interest in the social consequences of scientific discoveries may grow stronger.

Since the British Association has failed to take action, it is possible that the British Science Guild, which was founded in 1905 "to promote the application of scientific method and results to social problems and public affairs", may be induced to make some definite proposals for bringing scientific work and thought to bear upon social problems. At least some effort might be made to secure wider support for the task the Guild has undertaken of compiling a volume which will indicate the value of the contributions science has already made to our national progress, and the potentialities of science in the evolution of a better order of society.

Apart from Prof. MacDougall's eloquent appeal in Manchester last year for research into the social sciences, and the discussions at the centenary meeting of the British Association, there have not been wanting other similar proposals. Some time ago, Dr. G. E. G. Catlin, professor of politics in Cornell University, outlined a scheme for the formation of a social science research council in Great Britain, covering all social fields of scientific study and scientific fields of primary social relevance. The council would not only act as a clearing-house of information on scientific work in social sciences, and provide a means of obtaining competent repre-

sentatives of the social sciences on other national bodies, but would also act as a controlling organisation to which the Government could turn to sponsor independent and impartial research into social and economic problems. It was not proposed that the council should directly undertake research, or even become a mechanism for co-operative research, although the supervision of specific pieces by *ad hoc* committees might come within its scope. It was rather suggested that the council would provide a source of disinterested expert advice on social matters, which is indispensable in national planning, but is not satisfied by the Economic Advisory Councils hitherto appointed.

If it is disappointing to find that the British Association itself was unwilling to take up the suggestions made at the York meeting, it is at least encouraging that the responsibility of the man of science in these matters has been publicly admitted before such a representative gathering. It is to be hoped that the suggestions may be crystallised by some other organisation into concrete and practical proposals which can be put before the scientific community as well as the community in general. When this has been done, the disposition of the ordinary citizen at the present moment to reflect that the application of the dispassionate temper of science to the difficulties of the hour might facilitate their settlement, should encourage the scientific worker to shoulder his responsibilities of leadership, of his capacity for which discussions at the recent British Association meetings on such matters as water supply, water pollution, the planning of markets, and the prevention of disease in animals furnished copious evidence.

The Alps and the Alpids

(1) *Diskordanz und Orogenese der Gebirge am Mittelmeer.* Von Prof. Dr. Wilfried von Seidlitz. Pp. xxiv + 651 + 14 Tafeln. 72 gold marks.

(2) *Das alpine Europa und sein Rahmen: ein geologisches Gestaltungsbild.* Von L. Kober. Pp. iv + 310 + 3 Tafeln. 20 gold marks.

(Berlin: Gebrüder Borntraeger, 1931.)

THESE two works are both by geologists who have spent many years of field work studying the tectonics of the most recently folded belt of the earth's crust. They are concerned with the same subject and, whilst they are completely different in style and at first sight not much alike in conclusions, they have one feature in common. This is that the tectonics of the Alps are not the normal Alpid tectonics. The Alps are a special and unique portion of the great Tertiary fold-belt of the Alpids. West Alpine geologists, fascinated by the spectacular nappe-displacements of their own mountains, have over-emphasised, quite naturally, the importance of similar structures in the remainder of the Alpid chains. The authors of these volumes are, as it were, seeking for a new point of view from which the Western Alps will appear in their proper perspective. They show that the history of the Alpids is more than a history of young folded chains, since the reaction of tectonic islands of old folded masses, thrust-tectonics of marginal regions, fracturing, torsion movements between earth-blocks, their rising and sinking, and the associated seismic and volcanic phenomena, are all of fundamental importance in the architecture of the mountain zones. Termier's shout of 1904, "Rien n'est en place, il n'y a que des nappes", appears with respect to its second half to be a somewhat premature expression of enthusiasm.

(1) The first part of von Seidlitz's book is concerned with general matters affecting the origin of the present Mediterranean region. Morphology, palæogeography, and igneous geology are considered. The importance of median masses (*Zwischengebirge*), as a sort of tectonic islands, and their contrasts to central massifs are examined. Old tectonic kernels, relics of pre-Mediterranean orogeny, have acted as obstacles in the path of the younger folding. The divisions of the orogenic belt are developed, whilst the great importance of fractures and torsional phenomena is emphasised. The correlation of seismic and volcanic happenings with tectonic events, dealt with in detail in the first part, is stressed throughout the book, and is illustrated by many of Sieberg's seismic maps.

In the second part there are given detailed tectonic analyses of the different Mediterranean regions. This part concludes with a discussion of the many syntheses of the Mediterranean Alpids—those of Suess, Termier, Kober, Staub, Stille, and Jenny—after which von Seidlitz develops a synthesis of his own. This depends chiefly upon the recognition of main and subordinate geosynclines and of two orders of median masses.

In the third part of the book an account is provided of the whole Mediterranean orogeny. Nine tectonic zones make up the complete belt. In the centre run the folds of the main geosyncline—Sierra Nevada-Corsica-Alps-East Dinarids-Taurids; this is flanked on either side by the inner median masses, followed outwards by the folds of the subordinate geosynclines, these by the outer median masses, and finally the folds of Jura type next the

forelands, giving nine zones in all. But this picture is complicated by the torsional structures caused by northward push in the western part of the Mediterranean and a southward push in the eastern part. As a result, great fracture zones run north-west and south-east, chief of these being the Ægean, Ionian, and Balearic.

(2) Kober's style is completely different from that of von Seidlitz. It is comforting but unusual to find a scientific work in German, or for that matter in any language, in which the majority of sentences have no more than six to a dozen words. This machine-gun, Bart Kennedy style, reinforced by simple diagrams and innumerable summaries, makes Kober's exposition of his views exceedingly clear and attractive.

In his "Der Bau der Erde", Kober developed the bilateral theory of orogeny, in which fold-mountains are considered to be produced by the approach of two rigid portions of the crust, with the consequent over-thrusting of the median portion upon the two advancing blocks. On this theory, a descendant of Elie de Beaumont's 'jaws-of-a-vice' theory, the northern stem of the Alpid chain is thrust northwards on to Europe, and the southern stem southwards on to Africa. In this present work, Kober develops the theory in greater detail. He classifies each orogenic stem into the Externids (for example, the Helvetids of the Alps), the Metamorphids (for example, the Penninids), the Centralids (for example, the Austrids or East Alpine nappes), and the Internids. The last form the median masses or *Zwischengebirge* and show basin range structures. From the Alps, these zones are traced throughout the whole of the Alpid fold-mountains of the Mediterranean region. The importance of the pre-Gosau movements is constantly stressed. The last half of the book deals with general questions, such as the application of Kober's divisions of the orogenic belt to the Variscan folding of late Palæozoic date, the time-sequence of events in the Alpid folding, and comparisons and results. In this section some excellent tilts at the geophysicists will cheer all field geologists.

A comparison of Kober's present synthesis with that given in his "Der Bau der Erde" of 1928 shows little change except in the western Mediterranean. The Celtiberian chains are now outside the main Alpid arcs, the Betic cordillera being joined through the Balearics to Sardinia and Corsica. Further, a comparison of the results of Kober and von Seidlitz shows a surprisingly large amount of agreement, in spite of the great difference in treatment and outlook of the two authors. Both books are works of first-class importance to all students of tectonic geology.

The typography of these books is excellent, the misprints are exceedingly few, and the diagrams, plates, and illustrations uniformly good. Von Seidlitz's book is equipped with a fairly comprehensive index, but, as in the case of "Der Bau der Erde", Kober is satisfied with an extended list of contents—a blemish in books of this size and diversity.

H. H. R.

Creative Man

The Emergence of Man. By Gerald Heard. Pp. 303. (London and Toronto: Jonathan Cape, Ltd., 1931.) 10*s.* 6*d.* net.

THIS new book of Mr. Gerald Heard is a welcome sequel to the earlier one on the "Ascent of Humanity", which was noticed in NATURE of Aug. 9, 1930, p. 196. It is an advance upon it, because it deals more specifically with the known facts of history, and is for that reason more easily grasped by the person of average literary education and more likely to influence such a reader in the direction of co-ordinating his scattered fragments of historical knowledge. We welcome it specially because the author appreciates in a general way, and with enthusiasm and confidence, the rôle of science in building up civilisation, and leaves us in the last pages, if somewhat breathless, at least not prostrate. The richness of our discoveries and the glory of the prospect now revealed to us in the future by the action of man's mind, directed by science, cannot mean that civilisation is bankrupt and that we are standing on the brink of a moral and economic precipice. *Possunt quia posse videntur.*

The criticism which occurs is therefore not destructive but complementary; one would like the thought more completely worked out on its own lines. These lines are fundamentally sound, and often enlightening and suggestive of further thought in the same direction; but it would be a serious illusion, and sometimes a positive error, to rest in the brilliant impressions thrown out, especially in the earlier and more speculative portions. Thus it is constantly suggested that the primitive man is bursting with new ideas; life and thought are 'emerging'; a flash comes which creates an epoch; and so on. What one feels most strongly in reflecting on the—to us incomparable—slowness of the evolution in these prehistoric millennia, is the subtle and imperceptible way in which the steps must have been achieved.

Mr. Heard gives us vivid pictures of the way in

which the pre-humans drove off their first lion, made their first fire, and drew their first magic bison on the cave-wall. It is all perfectly legitimate imagination and brightens up the story charmingly, but one is quite sure that actually the process was stumbling, painful, many times repeated, and approached at a hundred different angles. It is for this reason, among others, that it pays us better to study as profoundly as possible the documents and monuments which we possess to see what they tell us of the minds of the men and the society from which they sprang. Such was the patient work of Tannery on the science of the Greeks, and the same method is now being applied to the remains of ancient Egypt, which Mr. Heard assumes unquestioningly as the nursery of civilisation.

One example drawn from this field will illustrate the difference. The pyramids, says Mr. Heard, have been treated as the work of wretched slaves toiling under the taskmaster's whip. No whip could have done the marvel; the compulsion was a spell, an urge of magic. Here we have a sound criticism and a sound suggestion of another motive at work, but it is incomplete and does not touch what, from the point of view of permanence and constructive power, is the most important aspect of pyramid building. This surely is the attainment, at that age, of accuracy in measurement and in collective working which within its limits could not be surpassed. Here are two fundamental factors in the building, not only of pyramids, but also of the whole structure of science.

A similar criticism occurs when we read Mr. Heard's account of the Romans. He finds the Roman world "hardly creative at all", which seems a strange judgment when we reflect that the Roman world, consolidating the work of the Greeks, is the one social and legal structure which has survived the ages, and that we are still living in it. It is true, of course, that they were not creative in that sense of flashes of genius which bring new things ready-made into the world. But in the other sense, of fitting things together and making men work together, they were far greater builders than the Pharaohs of the pyramids. This is an essential part of the scientific organisation of society.

One third and last point before we resign ourselves to the pleasure of reading the book again and recommending others to do the same. Mr. Heard is inclined in the latest period again to underestimate the validity of the structures of thought and of social organisation which science has built up. He sees Bolshevism as the new settlement of the world which is likely to spread, though that is only using science at its own dictation and for its own ends. Revolutionists do not really desire or respect science, as witness the treatment of Lavoisier by the Convention. But this was an exceptional incident, possible only in time of acute political passion. We cannot argue from it, or from the Bolshevists' attitude to their own men of science. The whole world, now represented outside Russia by the League of Nations, has been brought together, and is now—with some halts and spasms—functioning as a whole, through the spread of science. Why should we be always assuming that the Bolshevists are bound to be too strong for us? It is a curious fact that people who do that never mention the League of Nations, and Mr. Heard is no exception to this rule.

However, the book as a whole is fresh, suggestive, and delightful, and one may hope it will stimulate both Mr. Heard and others to similar studies.

F. S. MARVIN.

Quantitative Pharmacology

Bioassays: a Handbook of Quantitative Pharmacology. By James C. Munch. Pp. x + 958 + 6 plates. (London: Baillière, Tindall and Cox, 1931.) 45*s*. net.

THE author has reviewed in this volume all the more important papers published to the end of 1929 which deal in a quantitative manner with the effects of drugs upon the body. That the task has been laborious is shown by the fact that more than 200 pages, nearly a quarter of the book, is devoted to the bibliography. The author hopes that his work will prevent duplication of effort in the future: it is certainly worth recommending investigators to consult it before commencing a research, both for methods available and also for results already obtained, either with the drug under examination or with those of similar composition or action.

Following short sections on technique and the interpretation of results, come chapters dealing with the drugs affecting the nervous system, the circulation, respiration, and the muscles. The last two are devoted to glandular products and a miscellaneous group of special drugs, which includes antisyphilitics, antitoxins, and the vitamins.

In a work of this character, some unevenness of treatment is bound to occur: for example, the assay of the extract of the posterior lobe of the pituitary gland is described fully enough to enable an investigator to perform the test without further reference to original work. With insulin this is not the case; a number of methods are briefly referred to, but only general indications as to the

most suitable are given, and even then the details are not sufficient to enable the investigator to carry out a test without reference to the original papers.

A more fundamental criticism may be made. Sufficient distinction does not seem to be made between tests carried out without the use of a standard and those in which such a standard is employed. It might be convenient to confine the term 'bioassays' or 'biological assays' to the latter; 'quantitative pharmacology' would then have the wider significance. Owing to the different responses which different animals of the same species give to the same dose of a drug, it is not always easy to duplicate results at different times or in different laboratories, even when large numbers of animals are employed. The use of a standard of reference enables comparable results to be obtained in different tests, since it prevents unavoidable variations in technique or in animal sensitivity from affecting the final result. For this reason, emphasis might be laid on the greater accuracy of those assays which have been carried out against a standard of reference. However, the book may be thoroughly recommended to all pharmacologists and others interested in the biological examination of drugs, of both vegetable and animal origin.

Telegraphy and Television

From Telegraphy to Television: the Story of Electrical Communications. By Lieut.-Col. Chetwode Crawley. Pp. xii + 212 + 24 plates. (London and New York: Frederick Warne and Co., Ltd., 1931.) 6s. net.

THE author's declared intention of giving "a bird's-eye view of telegraphy and telephony in all their branches, showing their history, development, attainments, and future possibilities", is not quite satisfactorily fulfilled in this volume. Full weight must be given to the difficulties of presenting, in two hundred pages of simple language, a clear story of the spectacular growth of electrical communications. Yet, full weight given, the present result is a little disappointing. The need for simplicity brings with it the danger of superficiality, and the treatment tends to be somewhat patchy, especially in the later chapters.

The hobby-horse is a poor mount on which to lead a pageant of history. There are two interlinked topics running through the volume which the reviewer finds peculiarly irritating. One is the general theme expressed, for example, in this comment on Hughes's experiments: "Orthodox science had closed the door on the invention of wireless telegraphy as it has so often attempted to do in the case of other important inventions". The other is the presentation of television in a way which fails to give the reader any estimate of the true technical and æsthetic position in television to-day. The author adds to the many disservices which television in Great Britain has already suffered at the hands of its friends by devoting much of the chapter headed "Television" to a series of quotations which will make the reader ask why it should be necessary to reassert with such iteration Mr. Baird's claims to priority. The topics are, as has been said, interlinked, as, for example, by the *obiter dictum*, "Marconi, like Baird to-day, was not in the least perturbed by the opinions of the most eminent physicists or anyone else".

To suggest, as these two quotations do, that there is any valid analogy amongst the three cases of Hughes, Marconi, and Baird, is to embark on a subject which cannot be left as the author has left it. Hughes—to whom the author does less than justice—was certainly the victim of a pontifical conservatism of the most unhappy kind. Marconi—whose special contribution to electrical communications the author states very fairly—received very generous encouragement from many practitioners of "orthodox science". The encouragement was very mildly tempered by a legitimate warning about the difficulties suggested by diffraction theory, a warning which he rightly put to the test of an experiment, the success of which greatly widened the boundaries of orthodox science. Baird—to whom the author does perhaps a little more than justice—has been warned by "eminent physicists" and workers in "orthodox science" (1) that there is more than one way of approach to television and (2) that the laws of physics do not allow him to give an æsthetically satisfactory service in the particular band of medium frequencies allotted to him under the laws of man. This is a very tenuous basis for the "atmosphere of captious criticism" which the author detects around television.

The final chapter of personal reminiscences, from one who has been in exceptionally close contact with the whole life-history of wireless telegraphy, is most interesting and entertaining. The book as a whole is interesting. The remarks already made prove that it may fairly be described as stimulating; the twenty-four plates make a substantial contribution to the picture which the author sets out to draw.

Short Reviews

Organic Syntheses. Collective Volume 1. Being a revised edition of Annual Volumes 1-9. Editorial Board: Henry Gilman, Editor-in-Chief; Roger Adams, J. B. Conant, W. H. Carothers, C. S. Marvel, H. T. Clarke, C. R. Noller, F. C. Whitmore, C. F. H. Allen, Secretary to the Board. Pp. ix + 564. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1932.) 37*s*. 6*d*. net.

IN this volume the editors have brought together for the convenience of their fellow-chemists the first nine volumes of "Organic Syntheses", containing authentic methods for the preparation of 260 substances. In doing this they have not contented themselves with merely rearranging the matter previously published, but have made a large number of relatively minor yet significant corrections, and have incorporated new and improved directions for the preparation of adipic acid, benzilic acid, cyclohexylcarbinol, dibenzoylmethane, *d*-glutamic acid, glycine, *dl*-methylethylacetic acid, pentaerythritol, and *n*-propylbenzene. At the same time the illustrations of apparatus have been re-drawn and the quantities of corrosive liquids and all solvents have been given both in cubic centimetres and in grams.

Not the least of the many difficulties associated with the preparation of a book of this type is the indexing; but in the volume under review these difficulties have been overcome so successfully that the indexes are among its more commendable features. There is a "Type of Reaction Index", listing most of the preparations in accordance with some general type of reaction, such as acylation, halogenation, and oxidation; a "Type of Compound Index", in which preparations are listed, where possible, according to the group introduced; a formula index, an illustration index, and a general index, all of which have been made accessible by means of thumb index marks. The references to the literature, although not intended to include every published method for a given preparation, are plentiful and up to date.

It is a work which has been carefully and skilfully compiled, and can be unreservedly recommended to every chemist who is concerned with the preparation of organic compounds.

A History of Aircraft. By F. Alexander Magoun and Eric Hodgins. (Whittlesey House Publication.) Pp. xx + 495. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 21*s*. net.

THIS is an extremely readable American publication, which does not, as several others have recently, give undue prominence to American achievement. Its record ranges from Archytas in 400 B.C. to Post and Gatty in 1931, and concludes with a chapter entitled "The Present", which happens to be principally an attempt to look into the future.

The authors claim to have exercised Lytton Strachey's requisite for the historian, "ignorance, which simplifies and clarifies, which selects and omits . . .", and in the historical sections, using a restraint compatible with this humility, they have produced a remarkably concise and accurate précis of the world's aeronautical history, both mythological and actual. With contemporary history they are less happy, in that they have been led into reporting opinions, obviously biased by local outlooks, that they, as historians, should have avoided. For example, it will be news on the eastern side of the Atlantic that Sikorsky, in Russia in 1916, was the first person to produce a successful twin-motor aeroplane. Perhaps the literal accuracy of this statement turns upon one's interpretation of the word "successful". Also, that Hawker after his attempt upon the Atlantic flight in 1919 "vanished from the public stage", apparently because of his political indiscretions. The last chapter, with its attempts at forecasting the technical developments of the future, is a tactical error, and mars what otherwise is an interesting and logically written book. It is not in place in a history, neither do the authors appear to be technically able to deal with it.

The general lay-out is excellent, divisions being made according to classes of aircraft. This, combined with a chronology at the end of the book, makes reference particularly easy.

Gems and Gem Materials. By Prof. Edward Henry Kraus and Dr. Edward Fuller Holden. Second edition. Pp. ix + 260. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 18*s*. net.

THE second edition of this useful work contains much new material, and is even more fully illustrated than the first. The work is divided, as before, into three parts—the first dealing briefly with the general properties of minerals, the second being concerned with descriptions of the individual gem species, and the third part containing tables of physical properties, etc., conveniently arranged for reference. A good index is provided.

The additional information concerning synthetic corundum and spinel embodied in the chapter on manufactured stones makes this one of the most valuable features of the book. A further improvement is to be found in the section on amber, which now provides an excellent account of the natural material and the properties by which it may be distinguished from its various imitations. The chapter on the cutting and polishing of gems has also been expanded. Less than two pages are allotted to the description of pearl, and the treatment is inadequate for so important a gem. The cultured pearl is briefly mentioned, but no account is given of the important modern methods used for distinguishing between natural and cultured pearls.

A mass of information is conveniently summarised in the concluding table (Table XI.). In this, wrong values are given for the specific gravity of benitoite, and the refractive indices of azurite and zircon—misprints which should be corrected in a future edition. The book is well produced and pleasant to handle, covering a wide field in a surprisingly small space. B. W. A.

The Microscopic Examination of Cattle Foods. By S. T. Parkinson and W. L. Fielding. Pp. viii + 97 (15 plates). (Ashford and London: Headley Bros., 1930.) 6*s.* 6*d.* net.

THE growing demand for detailed knowledge of the constituents of cattle foods has brought into prominence the need for adequate methods of analysis. Microscopic examination affords the only certain means of identification of the materials present, and hitherto a concise and systematic treatise dealing with the subject has been lacking. Parkinson and Fielding have now elaborated their own methods and have successfully attempted to set them out in such a way as to provide the student with a ready means of attacking a problem which bristles with difficulties.

The preliminary chapter is devoted to a description of methods, which are given in detail and would appear sufficient to meet most situations that are likely to arise. The main food plants are then dealt with in groups, including oil-containing plants, cereals, and leguminous plants, with a further chapter on such miscellaneous constituents as weed seeds, beet pulp, potato residues, and spent hops. Methods of identifying undesirable adulterants, such as sawdust, are also given to provide a test for purity. For each group, tables have been drawn up which enable comparisons between the different constituents to be made readily by selection and elimination. Additional information is provided by annotated photomicrographs of the chief features described and of the principal weed seeds. The volume meets a distinct need, and should prove most useful on the commercial side, as well as for training agricultural students in a better understanding of certain aspects of animal nutrition.

Cacao. By Dr. C. J. J. Van Hall. Second edition. Pp. xviii + 514. (London: Macmillan and Co., Ltd., 1932.) 28*s.* net.

DURING the last few years, increasing interest has been taken in problems relating to cacao cultivation and production. It is singularly appropriate, therefore, that a second and revised edition of what is generally regarded as the standard work on the subject should now make its appearance. In this new edition, the author, an acknowledged authority with wide experience of the crop, includes the results of all the outstanding work on cacao that has been carried out in various parts of the tropics since the appearance of the first edition in 1914.

The most notable addition to the work is the chapter devoted to breeding and selection. Here the author outlines the methods that are being adopted in such countries as Java, Trinidad, and Surinam to improve the yield and quality of the crop, and does not omit to point out the numerous difficulties that have to be faced. The information relating to pollination and fertilisation is of special botanical interest, as these phenomena in cacao have been so long shrouded in mystery, and it is only in recent years that light has been thrown upon them. The account of the improved technique in budding that has now been evolved should be of value to all those concerned in any way with propagation. In the chapter devoted to pests and diseases much that is new has been added, including accounts of the valuable work that has been carried out in this sphere in the West African cacao-producing countries.

The Phenomenology of Mind. By G. W. F. Hegel. Translation, with an Introduction and Notes by J. B. Baillie. (Library of Philosophy.) Second edition, revised and corrected throughout. Pp. 814. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1931.) 25*s.* net.

THE philosophy of Hegel is for the very large majority of people a closed book. Of all the philosophers, he is by far the most difficult to understand, and Sir James Baillie has performed a very great service in translating and editing a new edition of his "Phenomenology of Mind", which may be fairly looked upon as Hegel's *magnum opus*. The subject matter is, however, so abstruse that it is very difficult to understand, and a modern psychiatrist might be forgiven for regarding some of it as definitely dereistic thinking, a term which Bleuler has well defined as thinking away from reality.

The translator has very much lightened the reader's task by a well thought out and reasoned introduction of some fifty pages. We think it might well have been indicated, when discussing phrenology and physiognomy, that the ideas of Lombroso are not necessarily accepted by scientific criminologists of to-day. The value of the table of contents has been very much enhanced by the addition in brackets of remarks of the translator. These help to clarify the plan of the work, and help the reader on what cannot really be otherwise than a weary way.

Solutions superficielles, fluides à deux dimensions et stratifications monomoléculaires. Par André Marcelin. (Recueil des Conférences-Rapports de Documentation sur la Physique.) Pp. 163 + 4 planches. (Paris: Les Presses universitaires de France, 1932.) 80 francs.

M. MARCELIN's book will be heartily welcomed by all those workers who are concerned with the chemistry and physics of surface phenomena. The author opens the book with a historical exposition, and, after a brief discussion of the physical state of surface solution, goes on to describe in full detail and very clearly the experimental methods in use to-day. He then, by means of a very full discussion of surface solutions of oleic and other acids, illustrates the properties of and regularities shown by such solutions.

Very interesting chapters follow, dealing with pseudo-solutions and their transformation into true surface solutions, and with the equilibrium between a solution and a surface solution. The influence on the Volta effect produced by the presence of a monomolecular layer is very carefully examined, and the book closes with an account of the properties of thin films. It is fully documented, is written with admirable clearness, and is a notable addition to a notable series. ALLAN FERGUSON.

Some Aspects of Applied Geophysics *

By Prof. A. O. RANKINE, O.B.E.

PERHAPS some apology, or at least explanation, is necessary for the choice of a subject for which I have not even been able to find a satisfactory title. Applied geophysics may clearly be taken to include certain aspects of meteorology or oceanography, or, indeed, any branch of knowledge in which physics is applied, in the service of mankind, to the elucidation of the properties of the earth. I propose to deal with what is in fact only a limited field of work. Put briefly, it covers the application of physical methods to the examination, without digging or boring, of what lies beneath the surface of the earth at relatively shallow depths of less than a few thousand feet. The application is more particularly directed to the discovery of deposits of economic importance, such as minerals or oil, or the structural formations with which they are likely to be associated.

Truly this is a subject as different as it could very well be from those flights of theoretical physics—relativity, quantum theory, wave mechanics, and the like—which those of us with slower minds and more pressing other occupations try so desperately to follow. In our admiration and, perhaps, envy of the apparent ease with which the pioneers in these new fields make progress, we are inclined, wrongly, I think, to allow it to be assumed that modern physics and atomic physics are one and the same thing. It should not be overlooked that physics is making rapid strides forward also in other directions. Much that is new in the precision of measurement, in the choice of methods, and in the invention and design of physical tools for the attack on old problems hitherto unsolved, has been added to our knowledge in recent years. This is true with regard to the particular branch of physics we are now to consider. Its fundamental basis is not new. It involves no appeal to, let us say, wave mechanics; the old gravitational theory of Newton and the electromagnetic theory of Maxwell serve well enough our purposes. Yet its successful application continues to demand the highest experimental skill that training in physics can provide, and initiative ability equal to that more frequently directed in less practical channels.

The subject is also a border-line one, and, perhaps for that reason, has not received so much attention as it deserves, at any rate in Great Britain. Its practice involves the co-operation of geologists with physicists, except in those rare examples of the same person being expert in both branches of knowledge. It was a famous geologist, the late Prof. de Böckh, who suggested to the equally famous physicist, Baron von Eötvös (whose work we shall consider more fully later), that the Eötvös torsion balance should be used to locate and delineate buried salt domes—geological features with which oil is frequently associated. Prof. de Böckh once told me that at first Eötvös was horrified at the idea. He regarded the use of his instrument for such an economic purpose as debasing science, and it was only with great difficulty that he was eventually persuaded to initiate what has now become a common and successful practice in various parts of the world.

I may perhaps mention, too, that when I first became interested, about five years ago, in applied geophysics, I was very doubtful of its use. Could conditions underground, I asked myself, ever be so simple and free from complications that physical observations on the surface would point unequivocally to the solution ? The answer to this question is, generally speaking, in the negative ; but here the geologist comes in again. He carries out his preliminary survey by his own methods, and is often able to indicate both the limited region where a geophysical survey seems desirable and, in a general way, the kind of formation which is to be sought, thus enabling a suitable choice of method to be made. He provides, in fact, the *selection rules* for the geophysicist, in much the same way as the quantum theorist does for the spectroscopist, as regards both where to look and what to expect to find. It is true that sometimes a *forbidden* result persists in obtruding itself inconveniently upon the geological interpretation, just as a *forbidden* spectral line may refuse to be extinguished. But usually the solution of a problem has to depend upon the combined result of geological and physical evidence, and is only approximate at that.

It is mainly the physical basis of the work that I wish to review. Here I should point out that this limitation will exclude 'divining', whether for water or any other underground feature. Innumerable claims of successful use have been made for the divining rod and similar indicators, but the *modus operandi* has never been explained, and none has been established on an acceptable physical basis. But I am glad to escape from this highly controversial ground by defining in a sufficiently exclusive manner what is a geophysical method in relation to the search for minerals. The basis of every geophysical method is the differentiation, usually abrupt, of some physical property as between rocks. The four principal methods—gravitational, magnetic, seismic, and electrical—depend, in fact, upon differences, in the various media underlying the earth's surface, of density, of magnetic susceptibility, of velocity of elastic wave propagation, and of electrical conductivity respectively. Associated with these variations of physical properties, either naturally or through stimulation by artificial means, there are produced, at or near the earth's surface, calculable physical effects which may be capable of measurement by suitable apparatus. There must be something physical to measure, and the instrument must be able to measure it.

* From the presidential address to Section A (Mathematical and Physical Sciences) of the British Association, delivered at York on Sept. 2.

THE GRAVITATIONAL METHOD

I do not think that Eötvös has yet received in Great Britain the full recognition which his work deserves. Possibly this is because the early accounts appeared in rather inaccessible journals; or, possibly, there were real doubts concerning the validity of his claims. I remember, as a student, hearing vaguely about his experiments—and his name, without anyone knowing how to pronounce it. In the same lectures we learnt much fuller details of Boys's classic measurement of the constant of gravitation, without realising how remarkably similar in essential form the Eötvös and Boys instruments were. But the fact is that when Boys was inventing and making the quartz fibres for his torsion balance to weigh the earth, Eötvös had already tackled successfully the difficult task of making robust and portable for field work another torsion balance of not greatly inferior sensitivity. While Boys was busy with his measurements in a constant temperature cellar, Eötvös was completing the protection of his portable instrument against the temperature variations inevitable in the rigours of the field. A few years later he made notably successful gravitational surveys on the frozen surface of Lake Balaton and on the Great Hungarian Plain; but it was not until Shaw and Lancaster-Jones had demonstrated in 1923 that an Eötvös balance, acquired for the Science Museum before the War, behaved according to specification, that the remarkable nature of Eötvös' achievement began to be appreciated here.

Even now I do not think it is well enough understood how small were the effects which Eötvös measured under the unfavourable conditions of field work. We can illustrate this in a very striking way. The earth's gravitation field, even apart from local irregularities, is not uniform, or, rather, spherically symmetrical. Owing mainly to the earth's rotation, the apparent value of the gravitational intensity increases in passing from equator to pole. The total change is about 5 cm./sec.^{2}, and the maximum rate of horizontal variation is at latitude 45°. In this region the change of g for a step of one metre northwards is 8×10^{-7} cm./sec.^{2}, or, approximately, only one thousand millionth of the gravitational acceleration. This the Eötvös torsion balance was capable of indicating definitely, being several times as large as the limit to which the instrument would respond. Further, the measurement could be made with the instrument occupying a single position in a space of less than a square metre, simply by making observations with the apparatus as a whole in a number of different azimuths. Eötvös, in effect, multiplied by a thousand the accuracy of measurement of terrestrial gravity variations.

This remarkable sensitivity was secured by deliberately excluding gravity itself from exercising any control in the instrument, which was constructed so as to respond only to *variations* of the gravitational field.

It would take too long to describe the instrument, and at the same time do justice to those used in other branches of geophysical surveying. It must suffice here to indicate that the Eötvös torsion balance provides means of measuring, normally by observations of the changes of torsion accompanying changes of azimuth of the instrument as a whole, two properties of the local gravitational field, each having magnitude and direction. The magnitude of the first, for which a satisfactory name has not yet been devised—the *horizontale Richtkraft* according to Eötvös—is the product $g(c_1 - c_2)$, where c_1 and c_2 are the greatest and least curvatures of the local 'level' or equipotential gravitational surface; its direction is horizontal and in the vertical plane of least downward curvature. The other departure from gravitational uniformity which the balance measures is the *gravity gradient*, or the rate of change of the vertical gravitational intensity with horizontal distance in the direction in which the change is greatest. It is a vector, and both its magnitude and direction can be obtained from the instrumental observations.

The reaction of the instrument to these two differential 'fields' provides the means of measuring the particular gravitational distortions which they represent. This part of the work is pure physical measurement of a straightforward character, and attaining, as I have indicated, a surprising degree of precision. It is in the interpretation of the results that the real difficulties arise. The problem is to ascertain to what extent the gravitational irregularities measured are due to density differences in the buried structure, and to assign to the latter a position and shape consistent with the observations. In country where the surface is otherwise than virtually horizontal it is necessary to survey its irregularities and make calculated allowances for their contribution to the total measured gravitational distortion. This topographical effect may indeed sometimes be so large in comparison with that of hidden structure as to render gravitational surveying ineffective. The earth's rotational effect, of course, has always to be eliminated, but this presents no difficulty. What remains after these corrections constitutes the data for geophysical interpretation; and this is the stage where the geologist's 'selection rules' have to be applied. As in all geophysical methods, interpretation is necessarily indirect. Underground structures, agreeable to the geologist's experience, have to be taken as hypotheses, and tested by calculation and comparison with the data provided by surface observations.

I have, rather regretfully, to leave at this stage this part of my subject. My recent practical experience with torsion balances has aroused in me the greatest admiration for the work of the original inventor and his successors, and for the skill and precision with which most of these remarkable instruments have been constructed by the makers. It comes as something of a shock, even though we do not doubt the universal law of gravitation, to see for the first time a small mass of gold being attracted by a neighbouring lead sphere a few inches in diameter. With a torsion balance at our disposal the same becomes commonplace, and is indicative of the great power of these instruments

for geophysical purposes. Accumulated evidence from the field confirms this view. There is convincing proof that extensive underground features, such as salt domes, limestone anticlines and synclines, rock faults, and deposits of hæmatite or of brown coal, produce, if not too deeply buried or masked by complicating irregularities, gravitational disturbances large enough to lead to their delineation.

THE SEISMIC METHOD

The seismic method of prospecting began to be used about 1919, chiefly owing to the initiative of Mintrop. To some degree it has replaced the gravitational method, on account of the greater speed with which it enables a given area to be surveyed—a most important economic criterion, of course. But there are other important reasons why, under certain conditions, it must be preferred. If, for example, the topography of the country is too irregular for the corresponding corrections to be applied reliably to torsion balance observations, gravity surveying is excluded; and seismic work, which is not so sensitive to surface conditions, may still prove of value. Again, the structure to be determined may itself settle the choice of method. For example, if the problem were to determine the depth of a horizontal interface of discontinuity between two strata of very great extent, the torsion balance would not find anything to measure; the seismic method, on the contrary, would be confronted, as we shall see, with its most direct and simplest task. But while admitting these undoubted advantages, and recognising the many notable successes of seismic surveying under suitable conditions, it is necessary to state that this method does not yet rest on so sure a theoretical foundation as the law of gravitation: nor do the portable seismographs employed give records so unambiguous as the readings of the torsion balance.

The basis of the seismic method is the same as that underlying the investigations of the propagation of earthquake shocks in relation to the determination of the structure of the earth's crust. The difference is only one of degree. In so far as there is a theory of natural earthquake propagation, it serves also for the seismic method of geophysical prospecting. In trying to determine the depth of an underground stratum, the most direct method of attack would be to measure, if possible, the time of travel of a particular disturbance from the surface to the interface and back to the surface after reflection. This method has been used with great success in determining the depth of the ocean by means of the Admiralty echo-sounding machine. But it fails in application to the solid earth, for the reason that the attenuation of vibrations with distance is far greater in the earth than in the sea; consequently, much larger initial disturbances have to be used—in fact, violent explosions. Even if—as ought always to be done for the sake of efficiency—the explosion is arranged so that the surface of the ground is not broken, thus eliminating danger to observers, the delicate seismographs cannot as yet be properly protected against the direct effect. They would thus be so greatly disturbed as to mask completely the onset of the small reflected disturbance arriving shortly after. This effect, indeed, persists to a less but still important degree even when the seismograph is removed to quite large distances from the explosion. It is true that some important results have been obtained by employing this so-called reflection method, but the reading of the records is a matter of considerable uncertainty, owing to the difficulty of identifying the time of onset of the reflected disturbance in the midst of the effect of that propagated directly.

This uncertainty has led to the more general adoption of a method, properly called the diffraction method, although the term 'refraction' is sometimes incorrectly used. Its great advantage is that it enables the inevitably feeble disturbances, which have penetrated to and through the lower medium, to reach the seismograph, under certain conditions, *in advance* of the much greater direct wave. Consequently, the times of arrival of these indirect, or diffracted, disturbances are recorded unmistakably upon the seismogram, however much the instrument may be agitated later on.*

The principles of the method can be readily applied to structures less simple than a single horizontal interface; and the observations obtained in the field, plotted on time-distance graphs, enable such features as the slopes and curvatures of strata and the depths of more than one successive bed to be recognised under favourable conditions. For success the principal requirement is a large velocity-ratio as between the rocks constituting the various beds. Salt domes under alluvial deposits, for example, are in this respect suitable structures, and the location of many such domes was the first achievement of the seismic method. It has also been employed with valuable results in determining the underground contours of limestone anticlines and deep-seated granitic basements at depths of several thousand feet.

THE MAGNETIC METHOD

We pass now to the magnetic method. In actual practice it is the simplest and least costly. It consists of measuring, with suitable portable magnetometers, local variations of components of the earth's magnetic field, usually the vertical and horizontal intensities. The instruments which have been designed for the purpose enable observations to be made quickly, so that a large number of stations can be occupied and a wide area covered in the course of a single day. Under suitable conditions, therefore, much information regarding underground structure may be obtained by means of a survey lasting only a relatively short time and involving comparatively little expense. But it should be pointed out that this apparent economy has sometimes led to the method being employed on problems for which it is at present unsuitable, and to claims being made as to its performance which are doubtful.

It is necessary to bear in mind that the basis of magnetic surveying is the differentiation of rocks in

* The theory and practice of the seismic method is discussed in articles in NATURE, 123, 684, 718, May 4 and 11, 1929.

respect of magnetic susceptibility, and the consequent discontinuities of magnetisation under the influence of the earth's general magnetic field. For the field distortion thereby produced at the earth's surface to be marked, it is necessary for the responsible rock structure to have a large susceptibility; this implies that only highly ferruginous rocks will be easy to find.

I do not mean to imply that the magnetic method of surveying is limited to the detection of ore bodies like magnetite. Igneous rocks generally, and particularly basalt, may contain considerable quantities of iron, and consequently possess an effective magnetic susceptibility much larger than non-ferrous materials. There is abundant evidence that structures of such rocks have been determined, under favourable conditions, by the use of magnetic variometers. But if we are to hope to bring within the scope of the magnetic method non-ferruginous underground formations, we must improve greatly the sensitivity of the instruments, and at the same time exclude the operation of certain disturbing factors.

The chief difficulty with the variometers at present available is the application of the corrections for diurnal variation of the earth's field and for temperature changes. If we could escape the necessity of applying the corrections which these important effects involve, we should feel much safer in attaching significance to anomalies only a few times larger than the limit of measurement of the apparatus.

A year ago I thought I saw the way to do this, and brought a method before this Section of the British Association. It was to make use of the essential principle which gives to the Eötvös gravity balance its extraordinary sensitivity, namely, to measure the space-variation only of the forces in question. I found later that Eötvös himself had worked on these lines, and actually constructed an instrument partially fulfilling the conditions; although it is not clear that he realised the full significance of complete success. I have to confess that unexpected practical difficulties of construction have so far prevented realisation, but I have not given up hope that a magnetic instrument can be constructed to operate in the same way as the proved gravity instrument. Accordingly, it may be worth while to indicate what a device of this kind might be expected to achieve.

The chief virtue of such a magnetic torsion balance is that it would discriminate between *time-variation* and *space-variation* of the earth's magnetic field. The variation with time of a magnetic field remaining spatially uniform would not affect it; it would respond only to a sufficient distortion in space. Calculation shows that with the magnets and suspending wires now available we could anticipate an instrument which would be just about sensitive enough to respond, in the average magnetic latitude, to the non-uniformity of the earth's main field. The additional lack of uniformity arising from diurnal variations, or even magnetic storms, is by comparison small, because the amplitude of the variations is only a small fraction of the total field, and they are very widespread in character; consequently, they would fail to disturb the instrument appreciably. We should therefore be able to attribute the distortion observed solely to local magnetic features, apart from a nearly negligible correction for general earth's magnetism. The effect of changes of temperature also would be comparatively small, for they would be proportional to the variation of field intensity over the limited space occupied by the suspended system, instead of to the full intensity at the station. In the gravity torsion balance they are, in fact, negligible, and they could be made equally so here.

Electrical Methods

I have left until last reference to electrical methods, not because they are of less importance, but because I am less familiar with them, and could not speak with any of the authority which comes from practical experience. Accordingly, I shall simply use this opportunity of directing special attention to the work of the Imperial Geophysical Experimental Survey ("The Principles and Practice of Geophysical Prospecting": Cambridge University Press, 1931), which operated in Australia from 1928 until 1930. This survey, under the leadership of Mr. Broughton Edge, whose extensive experience of electrical surveying is well known, was concerned chiefly with electrical investigations. It is, I think, no exaggeration to say that the report is the most comprehensive and authoritative treatment available of the subject of electrical surveying.

Future of Geophysical Surveying

Much, however, remains to be done in all branches of geophysical surveying, in order to put it on a more secure basis and to determine more certainly the scope of its applications. It must be confessed that until quite recently practically all the work was being done by German investigators. By its nature the work is necessarily costly. Except as regards some aspects of the construction and improvement of instruments, it cannot be confined to a laboratory; and, with the same limitation, it can rarely be an individual effort. Effective research in the field implies adequate scientific personnel, transport, labour, and materials, in addition to the instrumental equipment. If we are to make substantial progress in this direction, the expense must be faced.

I recognise that it would be foolish, as well as useless, to press now for the initiation of any costly schemes. But it is permissible to hope and believe that the subject will not be completely neglected in these difficult times. We can occupy the lean years in making ourselves more familiar with what is already known, and in conducting new investigations on a modest scale—as, indeed, is being done at South Kensington by the Imperial College with the assistance of the Department of Scientific and Industrial Research. Then, when the fat years come, and the mining industries again call for the help of geophysicists, we shall be found, at least, not wholly unprepared.

The Adequacy of Human Dietaries

HOW far the food ordinarily consumed by different individuals provides an adequate amount of the different dietary essentials, and to what extent an improvement in the diet might lead to a general improvement in health and wellbeing and a decrease in the incidence of disease, are important questions. The answers depend in the first place upon a knowledge of all the factors which go to make up a complete diet and of the quantity and quality of the food actually consumed. The essentials of a diet are now well established, but our knowledge of the adequacy of common diets is still very incomplete. The investigations of Cathcart and Murray on the diets of a number of families in St. Andrews have already been described (NATURE, **127**, 897, June 13, 1931): the same authors have now published the results of an investigation into the diets of 56 families in Cardiff and 57 families in Reading.*

In this survey a horizontal instead of a vertical section of the community was selected for investigation, since for all practical purposes further examination of the diets of those comparatively well off appeared to be unnecessary. The numbers involved in the study were 378 at Reading and 370 at Cardiff.

It was found that the 'man' value per family was 4·55 at Cardiff and 4·35 at Reading, the 'diet man' values being respectively 4·54 and 4·30. The calorie consumption per 'man' per day was at Cardiff 3174, obtained from 79 gm. protein, 114 gm. fat, and 441 gm. carbohydrate: the corresponding figures for the Reading families were 2906 cal., 75 gm. protein, 101 gm. fat, and 408 gm. carbohydrate. The distribution of the calories between the proximate principles was, in each case, about 10 per cent from protein, 32-33 per cent from fat, and 57 per cent from carbohydrate, a very similar distribution to that found at St. Andrews. The Cardiff families spent more money on both food and rent than the Reading families. Comparison with other studies indicates that these values are more nearly comparable with those of the Glasgow artisan class than with other groups in Glasgow or Dundee. The fat consumption of the English working classes appears to be much greater than that of the Scottish. The amount of the income spent on food is 70-90 per cent in Glasgow, 45 per cent in Dundee, and 57 per cent in Cardiff and Reading.

At Cardiff the families with the largest incomes consumed most protein: at Reading this was not the case. The Cardiff families also derived a slightly greater proportion of their protein from animal sources. In the case of the unemployed families, the Reading diets were found to be of lower caloric value than the Cardiff, but contained a higher proportion of fat. 8 Cardiff and 12 Reading families consumed 2500 cal. a man or less. This was found to be due chiefly to the improvidence of one or both parents: at the same time it was noted that the English families spend much more of their weekly income on rent than the Scottish.

At least 73 per cent of the mothers in the Cardiff families could be classed as good, and 93 per cent in the Reading families. It is of interest to note that in Cardiff the 'bad' mothers spent most on food (70 per cent of the total income), whilst in Reading it was the 'good' mothers who utilised the greatest proportion of the family income on the purchase of food (58 per cent).

Little or no evidence of any real under-nutrition, as compared with the rest of the community, in the children of the relatively poor families was obtained.

In this study, only the quantitative aspects of the diets were considered, and no attempt was made to determine their adequacy in minerals or vitamins. The Advisory Committee on Nutrition to the Ministry of Health has recently examined and criticised diets in common use taking these aspects into consideration.† A simple method of calculating the calorie, protein, fat, and carbohydrate content is described. It is pointed out that at least 80 gm. protein and 50 gm. fat should be consumed daily and that the percentage of calories derived from carbohydrate should not be much greater than 66. About 37 gm. protein or 5 per cent of the total calories should be animal protein, of high biological value: this can be obtained from cheese, eggs, fish, milk, and meat. Minerals and vitamins are provided by milk and milk products, fresh salad vegetables and fruits, liver, fish, especially fat fish and fish roes, and eggs: their intake should be adequate if each individual consumes 1 pint of milk daily, partakes freely of cheese, if one orange or tomato or helping of raw salad is taken daily, if 1 oz. a day of butter (or vitamin margarine) is given and if a fat fish such as herring appears in the winter menu once a week (or half a teaspoonful of cod liver oil is taken once a day).

A diet is not usually deficient in calories, but may be so in first class (animal) protein and in the protective foods which supply the minerals and vitamins: it is then a simple matter to improve it by supplying these dietary essentials. Scrutiny of the diets in the children's homes visited showed that cheese was rarely given, that salads were not supplied in winter, and that ordinary (and not vitamin) margarine was generally used. It is recommended that the diets be improved by giving 1 pint of milk a head each day, by including green vegetables and carrots in the dietary, as well as apples or oranges, by using vitamin margarine, and supplying cheese, ox liver, fish roes, herrings, tomatoes, and watercress. An important point is that the menus should be varied so that certain dishes are not served on one particular day of the week for weeks on end: in this recommendation the importance of stimulating the appetite is recognised as a factor to be considered in any dietary.

* Medical Research Council. Special Report Series, No. 165: Studies in Nutrition—An Inquiry into the Diet of Families in Cardiff and Reading. By E. P. Cathcart and A. M. T. Murray, assisted by M. Shanks. Pp. 28. (London: H.M. Stationery Office, 1932.) 6d. net.

† (1) Memorandum to the Minister of Health on the Criticism and Improvement of Diets. (2) Report to the Minister of Health on Diets in Poor Law Children's Homes. Ministry of Health: Advisory Committee on Nutrition. (London: H.M. Stationery Office, 1932.) 3d. net each.

Obituary

PROF. FRAN JESENKO

YUGOSLAV science, and the University of Ljubljana in particular, has suffered an irreparable loss by the untimely death, on July 16, of Prof. Fran Jesenko, professor of botany at the University of Ljubljana, in consequence of an accident in the Julian Alps.

Jesenko was born near Ljubljana in 1875. He was educated there and in Vienna, where he graduated in 1902. In 1901 he was appointed tutor to two Oriental princes at the Teresianum, the well-known college for boys in Vienna. A similar appointment in the family of Count A. Merveldt, with whom he travelled to Egypt, gave him a good opportunity to study the desert flora. He was afterwards commissioned by the Vienna Botanical Institute to study the flora of Petræa, and at that time he also visited Persia, whilst he was the first Slovene to travel through the Sahara. Upon his return from his travels he studied in Uppsala and Paris. It was during his stay in Sweden that he became an expert in ski-running, and throughout his life he always found time to cultivate that sport.

On his return to Vienna, Jesenko was appointed assistant to Prof. Czermak at the Vienna School of Agriculture, and in 1913 lecturer at the Vienna Botanical Institute. It was during this period that he began to devote himself to what may be described as his life work, namely, the evolving of a fertile cross between wheat and rye. At the fourth International Conference on Genetics, held in Paris in 1911, he was able to report the progress of his experiments in a paper, "Sur un hybride fertile entre *Triticum stativum* et *Seccale cereale*", whilst at the time of his death his research had advanced so far that the next step would have been the cultivation of the new cereal on a fairly large scale at an experimental farm.

Jesenko was corresponding member of scientific societies in Great Britain, America, Tokyo, Leningrad, Uppsala, and Paris. We may quote a few of his early works as follows: "Beziehungen zwischen der Lichtintensität und dem anatomischen Bau der assimilierenden Organe von Wüstenpflanzen" (1907); "Einige neue Verfahren die Ruheperiode der Holzgewächse abzukürzen" (1911–12); "Über das Austreiben im Sommer entblatterten Baume und Straucher" (1912); "Versuche über die Turgenszensdauer abgeschittener Pflanzensprosse" (1910); and "Über Getreide-spezies-Bastarde (Weizen-Roggen)" (1913).

In 1914 he was called up for active service, and during the War suffered seven months' internment in Bohemia, because of his sympathies with the Slav cause and the Allies. After the War, his opportunity came with the constitution of the new Yugoslav State. In 1919, Jesenko was first appointed lecturer, and then professor of botany at the University of Zagreb, and in the following year was transferred to the newly founded University at Ljubljana. Here he had all the hard work, but also the satisfaction, which attends pioneer work. He soon conceived the plan of marking off part of the famous Triglav Lakes Valley as a national park, a plan which, in spite of great difficulties, he succeeded in realising.

On July 12, Jesenko set off to join his students at their headquarters in the Triglav Lakes Valley. It is assumed that whilst stepping aside from the steep path up the Komarcha Crag to look at some plant, his heavy pack caused him to overbalance on the precipitous and treacherous slope. He was found by some tourists a little later, his spine broken. He was removed to Ljubljana Hospital, where he died on July 16.

Jesenko was an able linguist and spoke fifteen languages. He possessed a beautiful singing voice; at one time indeed it seemed doubtful whether he might not choose the career of a public singer. His death will be widely deplored, but most of all by his students, whom he imbued with his own enthusiasm and devotion to his work, whilst all who had experience of his kindness and generosity will regret the premature death of the man no less than that of the naturalist.

MR. HERBERT KNAPMAN

IN Herbert Knapman, registrar of the University of Reading, who died on Aug. 14 at the age of fifty-two years, the lover of music and philosophy and the tireless organiser had long survived the brilliant mathematician who went to Cambridge from Rugby in 1898, was second wrangler in 1901, Smith's prizeman in 1903, and a fellow of Emmanuel College from 1903 until 1909. He joined the staff of University College, Reading, in 1903 as a lecturer in mathematics. If as a teacher he inspired awe of himself rather than love of his subject, the intense thoroughness which was his second nature brought a measure of success, and for a time he was even interested in the technique of imparting knowledge. Nevertheless, the steady transfer of his energies to the field of administration was a congenial development, and although the co-ordination of innumerable details seemed to his colleagues sometimes to be a waste of his intellect, there is no reason for supposing that the services which he performed, especially just after the War and at the time of the foundation of the University, so much better than a man less able could have hoped to do, withheld him from any more valuable work that he might have accomplished. The only work which he did as a mathematician was on the Subject Index of Pure Mathematics for the Royal Society Catalogue of Scientific Papers.

Knapman's lifelong passion was for music, of which he had a wide and expert knowledge. His one published paper described some experiments in which he observed a series of harmonic undertones excited by a tuning-fork; the observations were forgotten until the effect was rediscovered twenty years later, and it is evidence of the extraordinary delicacy of Knapman's ear that while he recorded

that ten of the undertones could be heard easily, Dr. Bond, with the same fork, could distinguish the fifth only occasionally.

In spite of lameness, Knapman was for the greater part of his life a strenuous pedestrian; latterly exertion told visibly on him, and he could not easily resign himself to physical inactivity. When eye-strain, though temporary, threatened further to limit his powers, he became acutely depressed, and the end followed rapidly.

An abrupt manner belied fanatical devotion to the University, and impatience with stupidity was balanced by a ready approval of good work. His judgment of men and affairs was valued not only by his colleagues at Reading, but also throughout the wide circle of educational administration in which he was a well-known personality. The perfection of his routine remains, permanently to strengthen the office with which he was associated, but the wit that lit up suddenly the stormiest or gloomiest of committee meetings and played like summer lightning on the rare evenings when he gave himself up to social enjoyment is lost, except in the memory of those who knew him. E. H. N.

DR. J. STUART THOMSON

THE many friends and old pupils of Stuart Thomson will sincerely regret to hear of his death, at the age of sixty-four years, which occurred suddenly after a short sea trip, at Swansea, on Aug. 28. For many years Stuart Thomson, who was the brother of Sir J. Arthur Thomson, was senior lecturer and demonstrator in zoology in the University of Manchester, and many generations of medical and science students in Manchester had the advantage of his patient and sympathetic teaching. His wide knowledge of his subject—and particularly of vertebrate zoology—gave him authority in his lectures, which impressed those who heard him.

Stuart Thomson studied at Edinburgh and Freiburg, and also under Prof. Studer in Berne, who gave him an interest in the group of Alcyonaria on which in later years he became a recognised authority. He held teaching appointments in biology at Edinburgh and Plymouth, and in 1903 became assistant Government biologist at the Cape of Good Hope. In 1910 he returned, going first to Bristol and then to Manchester.

Stuart Thomson was the author of many valuable papers on the Alcyonaria of South African waters, all of them characterised by his patient investigation and careful description of detail. The last of these papers, published in the *Transactions of the Royal Society of South Africa*, in which the problems concerning the geographical distribution of the South African Alcyonaria are fully discussed, is of great general interest and a very remarkable piece of work.

In his later years Stuart Thomson devoted his spare time to the preparation of an elaborate memoir on the anatomy of the tortoise, of which no complete account has been published since the time of Bojanus.

Stuart Thomson resigned his post in Manchester in 1926, on account of failing health, and went to live with his sister in Cirencester, where he spent much of his time in preparing his book for publication. A few weeks ago he expressed the desire to go once more to sea, and his wish was fulfilled in a five days' cruise, but he died suddenly on landing at Swansea. S. J. H.

WE regret to announce the following deaths:

Dr. J. A. Clubb, formerly curator of the City Museum at Liverpool.

Prof. W. H. Sherzer, head of the Department of Natural Science at the Michigan State Normal College, known for his work in geological survey in Michigan, on July 17, aged seventy-two years.

Mr. S. Williamson Wallace, formerly director of the Egyptian Government College of Agriculture and director of agriculture for the State of Victoria, on Sept. 10, aged seventy-seven years.

Dr. A. Wilmore, formerly lecturer in geography at the Westminster Training College and principal of the Technical School, Colne, author of several well-known textbooks of geography and geology, on Sept. 6, aged seventy years.

News and Views

Forestry and National Economy

SIR JOHN STIRLING MAXWELL, formerly chairman of the Forestry Commission, has an article on "Forestry and National Economy" in the *Empire Forestry Journal* (vol. 2, No. 1, 1932). He confines himself to the work of the Forestry Commission in Great Britain and deplores the economy and cuts, which he admits were inevitable under existing conditions. Sir John himself gives the obvious reason why the heavy non-productive expenditure of the Commission could not hope to escape curtailment in the words: "It is unlikely that absolute continuity in the scale of forestry operations will ever be secured except where the expenditure in the forests is wholly met from the revenue they produce. It will be 30-40 years before this happy state of things can be reached in Great Britain." But he points out that the Forestry Commission can seize the opportunity offered and consolidate the work already accomplished and overhaul methods of organisation. In the dominions, the period at which the forests will pay their way may be reached earlier. In India it has been reached already. In the Crown Colonies, where the form of government is more autocratic, continuity ought to be easy of achievement when once the authorities realise the fatal folly of economising on productive expenditure. This latter point has already been alluded to in NATURE (June 11, p. 845).

IN discussing the present position of the Forestry Commission, Sir John gives a brief summary of the work of the first ten years. £9,000,000 was eventually sanctioned for the work to be carried out during the

following ten years. As a result of the May Report on Economy, the annual sum made available to the Commission was cut down by 50 per cent for the next five years. This cut has been met in two ways: first by reducing the provision of forest workers' holdings to the number absolutely necessary for the working of the forests, and, secondly, by stereotyping the annual planting programme at 20,000 acres or thereby, which will substantially reduce expenditure on acquisition of land. An expanding programme necessitates land acquisition on a large scale. Under a stabilised programme, acquisition can be limited to the replacement of the area actually planted. The reduction in area annually required works out at about 40,000 acres. These changes mean that the machine will take longer to arrive at its goal, but that it will not be thrown out of gear. No labour is to be paid off, and elasticity has been achieved partly by the distribution of the planting work all over the country and partly by the fact that the programme has been an expanding one.

National Research Laboratories, Canada

ON Aug. 10, the new National Research Laboratories of the National Research Council of Canada were officially opened in Ottawa by the Governor-General, the Earl of Bessborough. Among other speakers at the official opening were the Prime Minister of Canada, the Right Hon. R. B. Bennett, and Dr. H. M. Tory, the president of the National Research Council and the National Research Laboratories. A description of the building and the proposed organisation of departments and staff was given in NATURE of Jan. 4, 1930. The building is severely classic in style and closely follows the design of the architect's model reproduced in our article. It comprises four stories and basement, and encloses two large interior courtyards, which give ample light to all laboratory rooms overlooking them. Under each courtyard is an arched exhibition hall. There are three main divisions of research, namely, physics and engineering, biology and agriculture, and chemistry. There is also a division of research information which will be responsible for the publication of the *Canadian Journal of Research*, annual reports, technical reports, and bulletins. In the south-west wing is a series of industrial exhibits. Many delegates to the Imperial Economic Conference were present at the opening ceremony, and the Right Hon. Stanley Baldwin presented a number of portraits of eminent men of science which were given by Surgeon-Capt. Hanson.

National Research Council of Canada

THE Report of the National Research Council of Canada for the year 1930–31 states that although industry has been under a cloud, during the year the demand for scientific assistance addressed to the Council has increased greatly. There are now 29 research committees associated with the Council in the solution of scientific and technical problems which arise in industry, and the annual expenditure is a little more than 550,000 dollars. Five fellowships of 1200 dollars, 22 studentships of 1000, and 35 bursaries of 800 dollars a year have been awarded, and 35 researches conducted in Canadian universities have been assisted during the year. From the summaries of the activities of the associated committees and of the reports on assisted researches, it is evident that Canada is building up a corps of research workers whose influence on the future of her industries is likely to be most important.

New Mount Everest Expedition

A NEW attempt to reach the summit of Mount Everest will be made in 1933. The announcement of the expedition, which appeared in the *Times* of Sept. 3, is made by Admiral Sir William Goodenough and Brigadier-General C. G. Bruce on behalf of the Royal Geographical Society and the Alpine Club respectively. The last expedition was in 1924, when Mr. G. L. Mallory and Mr. A. C. Irvine lost their lives within some two hundred feet of the summit, if they did not actually reach the top. On the same expedition, Col. E. F. Norton and Dr. T. H. Somervell climbed to 28,200 feet. The previous attempts were in 1922, when a height of 27,300 feet was reached, and in 1921, when the expedition was a reconnaissance of the routes. Since 1924 the difficulty in renewing the work has been due to the unwillingness of Tibet to grant permission. Now, however, the Dalai Lama has given consent to a British expedition and arrangements are in active progress. The leader of the expedition will be Mr. H. Ruttledge, late of the Indian Civil Service, who has had considerable experience of mountain climbing in the Himalayas. The office of the expedition will be at the house of the Royal Geographical Society, South Kensington, S.W.7, and the secretary is Mr. J. M. Scott, who was a member of the British Air Route Expedition to Greenland.

New Archæological Periodical

THE new archæological publication *Préhistoire*, of which the first number has just been issued, has been planned on lines differing from those of any archæological periodical now running. Its contents will consist entirely of original memoirs, and it will include neither reviews of books nor current news; while in scope it will cover the archæology and art of the pre- and protohistoric periods, that is to say, from the earliest times up to the foundation of the great empires of antiquity. The articles will be descriptive—these dealing with the latest discoveries—statements of new theory, or syntheses taking a broad survey of facts. A special feature will be the illustrations, which in the case of each communication will be adequate to the requirements of the subject, and, in any event, more ample than could be given in the general run of archæological periodicals. It is hoped that the ampler space and fuller illustration which will be available, will make it possible to include in *Préhistoire* studies of which the publication has been impossible up to now owing to their requirements in these respects. The new journal is edited by M. Raymond Lantier with an international editorial committee, which includes, among others, Comte Bégouen, the Abbé Breuil, Mr. Miles Burkitt, Prof. Bosch Gimpera, Prof. H. Obermaier, and Dr. O. Menghin. The first issue contains contributions by

Dr. Henri Martin on the Solutrian sculpture of Roc, Prof. H. Obermaier on the late Magdalenian art of the Grotte du 'Pendo', near Santander, and a long and very fully illustrated study by Dr. R. Forrer of the prehistoric ritual chariot and its survivals in historic times (see Nature of Sept. 10, p. 404). Not only are the illustrations of each article ample, but they are also of a high quality. The price of Part 1 is 125 fr., but owing to the fact that the size of the parts will be variable, the price is not fixed. The annual subscription, however, is 250 fr. The publishers are Librairie Ernest Leroux, Paris.

Prof. J. W. Gregory

Following the obituary notice of Prof. J. W. Gregory by Sir John S. Flett (Nature, June 25, p. 930) and the letter of appreciation by Prof. Bailey Willis (Nature, Aug. 27, p. 310) we have just received a copy of an appreciation by Mr. F. Chapman, palæontologist to the Commonwealth of Australia, who was a lifelong friend of Prof. Gregory, published in the *Melbourne Age* for July 16. Much of Mr. Chapman's testimony is naturally concerned with Prof. Gregory's activities during the short period (1900–4) when he was professor of geology and mineralogy in the University of Melbourne. Victoria offered many fascinating geological problems ready to hand, and Prof. Gregory took advantage of these for a thorough training of his students in field work. One of his expeditions with a party of students to Central Australia resulted in his writing one of the finest geological essays, "The Dead Heart of Australia".

Prehistoric Persia

Should subsequent investigation confirm the tentative attribution of a date contemporary with Susa I. to the Stratum I. in the mound now under excavation by the American Institute of Persian Art and Archæology a. Damghan in northern Persia, the discovery fully justifies the claim for interest and importance made by Dr. Arthur Upham Pope in his letter to the *Times* of Sept. 12. He states that Dr. Erich Schmidt, field director of the expedition, has found in that stratum beautiful hand-made pottery and copper implements upon which he bases his suggested dating. He regards the lowest levels of the mound upon which the expedition is now engaged as coming very close to the fourth millennium B.C. Further evidence of this extension of the early painted pottery culture will be awaited eagerly. The important structure revealed in Stratum III., dating from about 2000 B.C., is of exceptional interest, not only on account of the singularly rich treasure of objects of high artistic merit in gold, silver, copper, and semi-precious stone, but also for the remarkable burial of a dancing girl which was found in one corner of the building. The body was laid out in dancing pose, with silver rings on the fingers, copper rings in the ears, long coiled armlets, a necklace of effigies of turtles in lapis and silver and a little copper lion, silver tubes, lapis beads, and other objects and ornaments in metal and stone. The mere catalogue of the finds calls up an intriguing picture of the magnificence of this early eastern court, of which, however, the significance will be much enhanced when something more is known of its cultural and artistic affinities.

Mohenjo-Daro Ideographs

A bold and entirely speculative attempt to arrive at the meaning of the pictographic designs on the seals found at Mohenjo-Daro, in the valley of the Indus, is made by Sir Flinders Petrie in the course of a notice of the recently published account of the excavations on this site by Sir John Marshall, which appears in *Ancient Egypt*, 1932, pt. 2. Sir Flinders Petrie justifies his method of attacking the problem by taking the ideographic signs in their primary sense of 'pictures' expressive of ideas, on the grounds, first, that being engraved on stone they escaped transformation and retained their original detail, thus being comparable with the ideographic method of Egypt; and secondly, that the study of official titles and the method of writing them in Egypt has supplied parallels to what may be discerned in India. Thus the recurrence of a number of strokes suggests that parallel to an Egyptian 'Home of Four', 'Five Men', and the like, we have a 'Hall of Four', 'Hall of Six', etc., pointing to a system of naming officials by the number holding office, like the Duumviri, Decemviri, etc., of ancient Italy. There is evidence for this method in Cappadocia. Another set of signs consists of wheels with six or four spokes, that is, chariots and wagons, signifying transport. 'Timber', 'water supply', 'an army', 'game', or 'hunting' are meanings suggested for other symbols, which, in combination with other signs suggesting authority, are interpreted as the designation of officials connected with departments of State; thus, 'Officials of the Registry of Chariots'. Nearly one-half of a hundred symbols are interpreted tentatively on the presumption that they are certainly ideographic signs such as lie at the base of Egyptian, Sumerian, and Chinese writing, but at so early a stage that the forms can mostly be recognised.

The 'Historical Society of Science', 1841

In *Isis* for July 1932, Mr. H. W. Dickinson gives an account of the Historical Society of Science founded in London in 1840 by J. O. Halliwell and Thomas Wright. Halliwell, who was born in Chelsea on June 21, 1820, and died near Brighton on Jan. 3, 1889, was a most remarkable man, and even as a boy had a passion for collecting MSS. He matriculated from Trinity College, Cambridge, in 1837, and before he was twenty years old had written a life of Samuel Morland and edited Sir John Mandeville's "Travels". In 1839 he was elected F.S.A. and F.R.S. The prospectus of the short-lived society for the study of the history of science said that its object was "to render materials for the history of the Sciences accessible to the general reader, by the publication of manuscripts, or the reprinting of very rare works connected with their origin and progress in this country and abroad". The Duke of Sussex became the president of the Society, and on the council were de Morgan, Palgrave, Baden Powell, Gardner Wilkinson, Prof. Robert Willis, and others. But though its start was an

auspicious one, the Society had but a short life and came to an end within a year. Halliwell—or Halliwell-Phillipps as he was called in later life—was a great writer on Shakespeare. He arranged and described the Stratford-on-Avon archives and initiated the movement for the purchase of the site of New Place, Shakespeare's residence there.

Whales Stranded in Scotland

SCOTLAND is favoured by the number of whales and whale carcases which are deposited upon its shores, and although this accident of position involves the expenditure of dealing with unsavoury nuisances, it has its scientific value. Accordingly a memorandum has been addressed to Scottish medical officers of health, sanitary officers, and the like, by the British Museum (Natural History), requesting the co-operation of these local officers in recording the stranding of whales, porpoises, and dolphins. Whenever a whale is stranded upon the British coast, a telegram, followed in due course by a detailed report, is sent to the Museum by the receiver of wreck or coastguard, and the Museum telegraphs to the sender to let him know whether the whole or any part of the whale is wanted, either for purposes of identification or for preservation. In this way much valuable information has been gathered in recent years regarding the cetaceans frequenting British waters and their seasonal movements; and the present memorandum aims at extending the scheme of notification. It states that as a rule a few days' delay does not affect the condition of a stranded whale, that a small whale killed by stranding can lie on a beach for as much as three weeks without giving rise to any serious nuisance and without entailing the slightest risk of infection, and that carcases moored in the water will keep quite well for as long as seven weeks. It is also pointed out that in this matter the British Museum is working in co-operation with the Royal Scottish Museum, Edinburgh, and that an eventual sharing of the specimens between the two museums has been arranged.

Protection of the Grey Seal

THE Fishery Board for Scotland has issued a notice directing the attention of fishermen and others to the provisions of the Grey Seals Protection Act of 1932. By that enactment a close time exists, between Sept. 1 and Dec. 1 inclusive, for the taking of grey seals (*Halichœrus grypus*). Any person taking, killing, or wounding any grey seal within the above-mentioned close season is liable on summary conviction to a penalty not exceeding £5, and any owner, master, charterer, or hirer of a boat, using or permitting his boat to be used for the purpose of taking, killing, or wounding grey seals during the close season, is liable on conviction to a penalty not exceeding £10.

Animal Groups in Philadelphia Museum

REGARDING our comment about the incongruous grouping of small mammals in certain cases in the Museum of the Academy of Natural Sciences of Philadelphia (July 16, 1932, p. 90), Mr. Leigh Mitchell Hodges, public relations director of the Academy, writes to say that the sole purpose of the cases in question was to bring together the outstanding examples of the small mammals common to Pennsylvania and New Jersey. No effort was made to exhibit them in their natural surroundings, the grouping being simply a convenient aggregation primarily for the education of school children. Nevertheless, the introduction of a certain amount of 'environment' might suggest to children the definite association in Nature of species not usually found together, and this possibility is what we had in mind. In the Museum as a whole, as is well known, great progress has been made in the development of habitat groups, the large cases illustrating lions, Kodiak brown bears, Stone's sheep, and Rocky Mountain goats being particularly fine examples of such exhibits. During the present year, groups of musk-oxen and whistling swans have been constructed, and the programme for the future includes cases of the giant sable antelope, African animals at a water-hole, and the giant panda of Tibet.

Hancock Museum, Newcastle-upon-Tyne

THE Council of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne has decided to issue an occasional museum bulletin, with the view of keeping members and associates in closer touch with the activities of the Society and the Museum. The first number of the *Bulletin* contains short paragraphs directing attention to the summer field meetings of the Society, the Museum wild-flower exhibit, and the new arrangement of the Abel Chapman collection of big game trophies and birds of prey. A curious addition to the collections is a hybrid between an English pheasant cock and a white Wyandotte hen, much larger and heavier than an ordinary pheasant, but very pheasant-like in carriage and shape and in the plumage of head, neck, back, and sides. Legs and feet follow the domestic fowl pattern, and the right leg bears a short spur. The bird tasted more of fowl than of pheasant. It is matter for regret that the increase of goldfinches in parts of Northumberland and Durham has attracted the professional bird-catcher, so that the beautiful birds are again threatened with extinction. A strong appeal is made for an increase in membership, so that the good work of this century-old Society may be continued unabated.

B.D.H. Book of Analytical Reagents

A SECOND, revised, and enlarged edition of "The B.D.H. Book of A.R. Standards" has been issued (price 2*s*. 6*d*. net; postage 6*d*. extra) by the British Drug Houses, Ltd., Graham St., City Road, London, N.1. Fifty new substances have been added to the 158 chemicals in the first edition, and the limiting values of the various tests have been stated at the head of each section in the form of a table which represents the maximum permissible limits for the various impurities. We may remind readers of NATURE that the letters A.R. (replacing the unsatisfactory description "Chemically Pure", or C.P., an unattainable ideal) denote analytical reagents of controlled and specified purity, and users of such reagents will thus be able, by means of this monograph, to judge what impurities may possibly be present and in what amounts. It is clear that, with improvement in analytical chemistry, some of the specifica-

tions may be given still further precision in future editions. The entry under copper oxide, for example, on p. 62, which returns nitrate, carbonate, and organic matter as "nil" on the basis of a rather crude test, is obviously capable of revision, and other cases will no doubt suggest themselves to the reader. For routine work, as distinguished from research, these specifications will be of considerable value, and the book will be found useful in all analytical laboratories.

Refractories

We have received from Messrs. John G. Stein and Co., Ltd., of Bonnybridge, Scotland, an interesting catalogue of refractory materials, dealing with various grades of firebricks, silica bricks, cements, retorts, etc. This firm has an output of one million refractory bricks weekly. All the clays required are obtained from the firm's own mines, and throughout the process of manufacture every factor is scientifically controlled, thus ensuring uniformity of products. The catalogue, which is well produced and illustrated in colour, gives a number of useful tables and formulæ, together with lists of the principal uses of the products. It contains some phase rule diagrams, for example, of the forms of silica and of the system $SiO_2 - Al_2O_3$, and a glossary of terms relating to silica and fireclay refractories. Special shapes will be made when required, the manufacturers being willing to cooperate in producing a satisfactory result in such cases. This catalogue is of a type which deserves every commendation, since it indicates a close cooperation of scientific and technical knowledge and a realisation of the importance of research in maintaining the quality of the products and in making progress in new directions, which are most encouraging.

Non-Ferrous Metals Research

The twelfth Annual Report of the British Non-Ferrous Metals Research Association shows that in spite of the industrial depression, progress has been well maintained. With a Government grant of £8000, the total income has been brought up to more than £25,000, proving that the industry has found the work of the Association of increasing value. In June 1931 the new headquarters in Euston Street, London, N.W.1, were opened, and visitors have been able to see how well the limited space available has been utilised for experimental work, and for the equally important work of collecting information and making it accessible to members. A study of the methods of the Association in this field would provide lessons for other research organisations, especially for such as have to make their results intelligible and serviceable to manufacturers, many of whom may have no adequate scientific staff to interpret the conclusions of the research workers. The subjects under investigation include many which are of interest to workers in pure science as well as to industrialists, and the results of these are usually communicated to a scientific society after they have been circulated to members. Whilst several of the investigations are now carried on at headquarters with the help of the equipment recently installed there, much research of importance is also in progress for the Association at the National Physical Laboratory, the Research Department at Woolwich, the University of Birmingham, and elsewhere.

Organisation of Living Things

In a short article in *Scientia* (Aug. 1932, p. 84) Dr. J. Needham discusses the problem of organisation and its place in the biological thought of the present day. Organisation is a property of all matter, and the organisation of living things is at one with material organisation, even if on a grade of its own. It is not something which controls or directs the material system, but is bound up with, and inseparable from, the organised matter itself. From this point of view organisation in the biological sense is something integral with the rest of scientific data, which science can take into account; and it will probably make necessary a widening and stretching of the classical concepts of physics and chemistry rather than an abandonment of them, so that a new mechanism will be evolved to include the modes of action and the organising relations found in living systems. Herein lies the central problem of biology, and biology will make progress only when, as has happened in physics and chemistry, attention is given to the theoretical principles which underlie and would co-ordinate the multifarious studies and researches of the field and the laboratory.

International Co-operation among Agricultural Brain-workers

Under the above title the Czechoslovak Academy of Agriculture has recently published in book form—in French, German, English, and Czech—the proceedings of a meeting of its corps of foreign members held at Prague on June 3, 1931, a matter which has already been referred to in this journal (**128**, 597; 1931). On this occasion detailed proposals were put forward by Dr. Reich, the secretary-general of the Academy, for furthering the international co-ordination of scientific and intellectual effort as applied to the agricultural domain. Among these was the original suggestion that an international 'Nobel prize' of the annual value of 1,000,000 Czechoslovakian crowns (approximately £8333) should be founded and awarded for the best piece of scientific work in agriculture. In this way it is expected that two important results will follow. In the first place, definite financial recognition can be awarded to investigations of outstanding merit. In the second place, an annual award of this character cannot fail to exercise a great moral and intellectual stimulus on the future development of agricultural science. An international committee, consisting of eighteen members, has been appointed to work out the details of the scheme and to collect the capital sum needed. In view of the fact that the welfare of industry is intimately bound up with that of agriculture and that in the future both must stand or fall together, it should not prove an impossible task for the nations to endow such a 'Nobel prize' for agricultural research.

British Association of Commercial Seed Analysts

The seventh Conference of the British Association of Commercial Seed Analysts was held on July 21 at

the National Institute of Agricultural Botany, Cambridge. The president, Mr. A. E. Birks, stated in his address that members are continuing to avail themselves of the facilities afforded by the Association, and during the year a number of interesting experiments were carried out by members working together. In one case, tests were made on a particularly difficult sample of asparagus kale in an endeavour to arrive at an equable result. The wide divergence in results obtained proves that there still remain factors governing the germination of this seed which are not fully understood. Mr. Harding gave an address on the comparison of soil and laboratory tests. He considers that soil tests properly carried out are of real value in estimating the maximum percentage of plantlets that can be obtained under field conditions. In some instances, when working upon new seeds, results from the laboratory and the soil tests are identical: greater differences occur when old seed is being tested. Finally, soil tests are certainly helpful when made in conjunction with the laboratory, as they assist in revealing discrepancies. The following officers were elected for the coming year: *President*, Mr. E. B. Wallace; *Vice-President*, Mr. A. E. Birks; *Hon. Secretary and Treasurer*, Mr. F. H. G. Neale, "Emmandee", Hawthorn Gardens, Reading.

Annual Report of the Ministry of Health

THE thirteenth Annual Report of the Ministry of Health, 1931–1932 (H.M. Stationery Office. 5*s*. net), recently issued, is in the main a record of the more important business transacted by the Ministry during the year, and does not cover matters of routine or detail, the Annual Report of the Chief Medical Officer of the Ministry being published separately as in previous years. Allusion is made to the British Postgraduate Hospital and Medical School, now in process of formation, for which a grant of £250,000 had been previously contemplated, but for which Parliament will now be invited to contribute a maximum grant of £100,000 in view of the exigencies of the time. The National Radium Trust has made further purchases of radium, and now owns a little more than 17 gm. Local authorities have been active during the year in the sewering of their areas, and loans sanctioned during the year amounted to nearly 7¾ million pounds. Other subjects dealt with in the Report fall under the main heads of public health, housing and town planning, local government and finance, poor law, and national health insurance.

Library of Educational Films

THE Empire Marketing Board has published a new edition of its film library catalogue, and copies are obtainable free on request from the Board, 2 Queen Anne's Gate Buildings, London, S.W.1. A great variety of films illustrating different aspects of scenery, natural history, and economic activity is now available. These cover most parts of the Empire. An important addition to the list is a series of class-room films, which are intended for the use of teachers rather than for general circulation. There are about forty of these films, some of which are travel surveys, while others deal with such subjects as canals, irrigation, cotton, wool, water power, or social life. All the films are available free for approved displays at which there is no charge for admission. Carriage must be paid by the borrower.

Cancer Mortality in the United States

DEATHS from cancer have increased alarmingly throughout the United States of America in the past year and a half, in the face of extremely favourable general health conditions. Science Service, of Washington, D.C., notes, under date Aug. 9, that figures compiled by the Metropolitan Life Insurance Company upon its industrial policy holders show a rise of 7·4 per cent in 1931, and for the first half of 1932, a further rise of 9·5 per cent over the rate for the like part of last year: the average rise in the period 1919–1930 was 1·5 per cent a year. Although official mortality statistics are not yet available for any large part of the country, the provisional reports are said to substantiate the Metropolitan figures.

Announcements

MR. WILFRED TROTTER has been appointed a member of the Advisory Committee on the Administration of the Cruelty to Animals Act, 1876, in succession to Sir Arthur Keith, who has resigned.

DR. JAMES LAW BROWNLIE has been appointed by the Secretary of State for Scotland chief medical officer of the Department of Health for Scotland in succession to the late Dr. John Parlane Kinloch.

THE annual exhibition of the Professional Photographers' Association was opened at the Princes Galleries, Piccadilly, London, W., on Sept. 5, and will remain open until Sept. 29. The exhibits comprise industrial photography as well as portrait work.

DR. HAROLD MOORE, who has for many years been director of metallurgical research at the Research Department, Woolwich, has been appointed, as from Oct. 1, director of the British Non-Ferrous Metals Research Association, to succeed Dr. R. S. Hutton, who has been elected to the new Goldsmiths professorship of metallurgy at the University of Cambridge.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mechanical engineering at the Swindon Technical College—The Director of Education, Education Office, Clarence Street, Swindon (Sept. 24). Inspectors for the purposes of the Diseases of Animals Act, 1894–1927, in the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Sept. 26). An assistant lecturer in engineering and a lecturer in production engineering at the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (Sept. 29). A lecturer in pure mathematics at the Wimbledon Technical College—The Principal, Wimbledon Technical College, Gladstone Road, S.W.19. A science master (chiefly physics) at the Prince of Wales' Indian Military College, Dehra Dun, United Provinces, India—The Secretary, Military Department, India Office, London, S.W.1.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Late Geological History of British Somaliland

DURING an expedition to explore the geology of British Somaliland, extending to 19 months spent there in 1928–30, much of the country was seen, with the possibly important exception of the coastal strip east of Berbera. It is hoped to publish the geological and palæontological results in due course, and specialists are now working out the fossil collections. The following details noted incidentally may help to supplement Dr. Parkinson's account of the late climatic changes.[1]

A most instructive district is the Bihendula-Dagah Shabell-Daban area[2] (within 40 km. south-south-east of Berbera), where the following succession was found.

1. *Daban Conglomerate*: Some buff shales and conglomerates with boulders and pebbles of Auradu Limestone (Lower Eocene); 111 m. thick in the Biyo Gora Section. In the Rhabka Hills, 6 km. farther east, it includes flint bands and a silicified band with a species of freshwater gastropod, ostracod marls, and fossil wood; thickness at least 270 m. The age is not at present known: it forms the top of the 2300 m. thick Daban freshwater series, which has an intercalation of fossiliferous marine Middle Eocene beds near the base. During its formation, a fault cliff appears to have existed south of the great east-west Dagah Shabell fault, whence fell enormous masses of Auradu limestone, including that of Agagwein, 1100 m. long, the Leopard Rocks, 190 m. long, and many of lesser size; these are embedded in the Daban Conglomerate.

2. *Posthumous Faulting* in the Gulf of Aden trend then took place along the Dagah Shabell fault and affected the Daban Conglomerate.

FIG. 1.—Terraces at Dagah Shabell, British Somaliland, looking south-west. Altitudes in metres. Motor truck by point marked 470 gives the scale. Golis Range in far distance.

3. *The Older Boulder Beds*, largely of Auradu limestone, were next deposited over the area, the material being derived from the high ground to the south. Traces of them are now found up to an altitude of 594 m. at Daghani (east of Bihendula), where one patch lies undisturbed across the Dagah Shabell fault. Immediately south of Dagah Shabell they are better preserved at rather lower levels (Fig. 1, at 528 m.).

4. *Erosion*: A drainage system independent of the underlying solid geology was then established on this gravel-covered area, and during what must have been a long-continued wet period almost the whole of the Older Boulder Beds were eroded from the Bihendula–Daghani area, and the underlying strata deeply cut into by several tugs, which flow almost due north, in a most spectacular manner. Across the strike and against the dip of these beds, which is steadily about 18° south, the superimposed Daghani Tug has cut narrow gorges through three hard Jurassic limestones, 244 m., 103 m., and 80 m. thick respectively, separated by two shales 250 m. and 113 m. thick (the outcrops of which are now occupied by strike valleys), through the Adigrat (? Triassic) Sandstone, 200 m. thick, the Archæan Igneous and Metamorphic basement (in which the narrow gorge is up to 60 m. deep), and, across the fault, through the concrete-like Daban Conglomerate. The Bihen Tug, at Bihendula, has cut a very similar course. The Biyo Gora Tug has cut a vertical-walled gorge only some 10-20 m. wide through the hard and massive Auradu Limestone of the Ali Wein Range (Fig. 2). These gorges were not cut along fault lines.

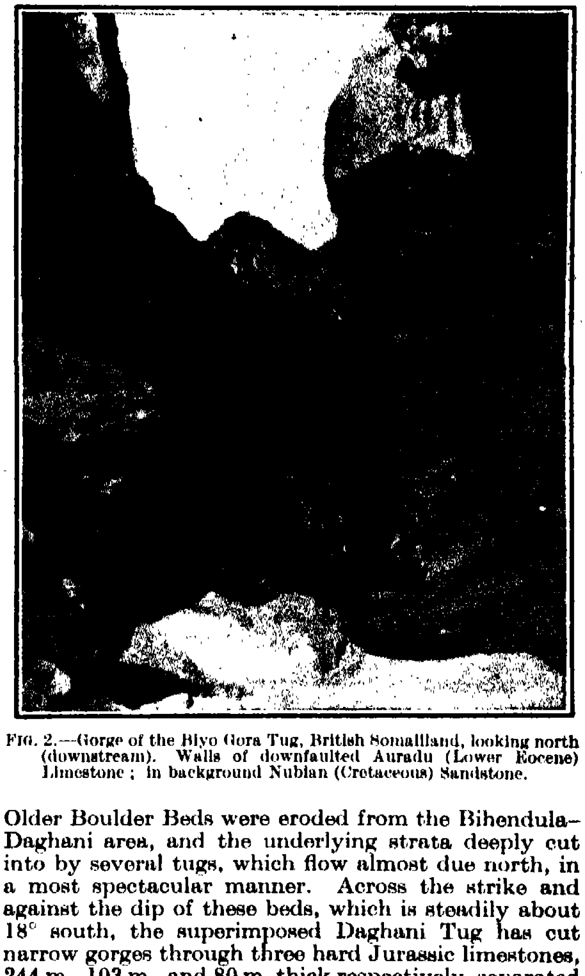

FIG. 2.—Gorge of the Biyo Gora Tug, British Somaliland, looking north (downstream). Walls of downfaulted Auradu (Lower Eocene) Limestone; in background Nubian (Cretaceous) Sandstone.

5. *The Younger Gravels* were next deposited in the valleys (Fig. 1, at 470 m.). These are mainly of Archæan igneous pebbles, but contain some of Auradu Limestone, and are locally largely made up of re-worked Nubian Sandstone and Shabell Beds (Cretaceous). A small tug cut in the Nubian Sandstone was found at Dagah Shabell completely infilled with Younger Gravel, and so not functioning in the present drainage system. During this period were deposited curious nests of Archæan boulders, two of which were found 4 km. and 8 km. respectively south-west of

Dagah Shabell. These boulders comprise an assortment of granitic types and are well rounded; the largest measured about 5 m. × 3 m. × 2 m., and must weigh some 70 tons.[3] The nests are not found in the present-day tugs but on the gently undulating gravel plain. The boundary of the nearest Archæan outcrop lies 11 km. and 7 km. respectively to the south-west.

6. *Erosion* of the Younger Gravels followed to some extent, but much is still left.

A thickness of 45 m. of gravel was measured resting on the Daban Conglomerate at one point, but it is uncertain to which phase this and the gravel cover over the Daban area should be referred.

Phase 6 may be that existing at the present day; the intermittent erosion now taking place would probably be adequate to produce the observed effects. A measure of the amount of erosion since the deposition of the Daban Conglomerate is given by the remnant of the Auradu Limestone cliff from which, if I am right, fell the great masses of limestone now found in that conglomerate on the north side of the Dagah Shabell fault. The three remaining fragments are seen in the Auradu Hills, 11 km. south of the Dagah Shabell fault, and rising perhaps 100 m. above the plain.

Evidence from the coastal district shows that various changes in the level of the land had meanwhile been taking place. At Dubar, 12 km. south of Berbera, at an altitude of 200 m. were found fossils which proved to be of an age not greater than Pleistocene, indicating a poorly marked raised beach. A series of limestone knolls 3-4 km. south-west to south-east of Berbera lie at altitudes of between 50 m. and 85 m. They are fossiliferous, but the hard limestone is much cut and polished by the sand-blast of the Kharif (south-west monsoon), and no fossils were collected. However, an older collection appears to have been made from here, and the fauna is again not older than Pleistocene, indicating a second raised beach. At Berbera is a third, well-marked, raised beach, at a level of 8 m. A correlation between raised beaches and gravel terraces was not possible, since in no case were the two found together: further search may remedy this.

Along the coast between Zeila and Bulhar, and again somewhat inland east and south-east of Berbera, are sand dunes of limited extent. In the latter area they are often of a reddish colour and clearly derived in part from the Nubian Sandstone on which they sometimes rest. They probably belong to the present-day period.

My thanks are due to the Somaliland Petroleum Co. Ltd. for permission to publish this note.

W. A. MACFADYEN.

Sedgwick Museum,
Cambridge,
Aug. 10.

[1] NATURE, 129, 651; 1932.
[2] See A. Beeby Thompson and John Ball, "Report on the Daga Shabell Oilfield (British Somaliland)". Govt. Press, Cairo, 1918.
[3] Cf. *Geog. J.*, 72, 416; 1928.

Molecular Weights of the Blood Pigments of *Arenicola* and of *Lumbricus*

IN a letter to NATURE of June 8, 1929, p. 871, one of us directed attention to the fact that all stable native proteins may, with regard to molecular weight, be divided into two large groups: the hæmocyanins with molecular weights of the order of millions, and all other proteins with molecular weights from about 35,000 to about 200,000. Among the proteins considered in that letter were three respiratory pigments, namely, the hæmoglobin of the vertebrates with a molecular weight of about 68,000, and two different hæmocyanins—that from the blood of *Helix*, possessing a molecular weight of about 5,000,000, and that from the blood of *Limulus*, of about 2,000,000.

We have recently had the opportunity to study the hæmocyanin from the blood of *Octopus* and have found it to be very different from the two hæmocyanins just mentioned, although of about the same molecular weight as the *Limulus* hæmocyanin. The sedimentation constant is higher and the shape of the molecule less asymmetrical. A few preliminary runs on chlorocruorin from the blood of *Spirographis* have further indicated that this respiratory pigment, like the hæmocyanins, has a molecular weight of the order of millions. With regard to the active group of the molecule, chlorocruorin is more allied to hæmoglobin than to the hæmocyanins, its characteristic element being iron and not copper. The fact that an active group containing iron and of semi-hæmin type is here associated with a protein carrier of about the same mass as the hæmocyanin molecule has led us to consider the possibility that there might exist other respiratory pigments of molecular mass of the order of millions but with the hæmin group of the hæmoglobin of the vertebrates.

If such respiratory proteins exist, they would most likely occur in the blood of the lower animals. Now, it is well known that several worms and molluscs have red blood. As a rule, the respiratory pigment of these animals is not in corpuscles but is in solution in the blood. This red protein has hitherto been considered as a form of hæmoglobin. J. and H. Barcroft have made a very thorough study of the absorption spectrum and of the affinities for oxygen and carbon monoxide of the blood pigment of *Arenicola*.[1] They arrive at the conclusion that the pigment is "of the same general type, but different in detail from that of human blood". We quite agree with these authors that the spectroscopic evidence as well as the behaviour of the pigment towards oxygen and carbon monoxide prove that its active group closely resembles hæmin, but this does not necessarily mean that the mass and the chemical properties of the protein part of the molecule are the same as those of the hæmoglobin of the vertebrates. The fact that it is not in corpuscles but dissolved in the blood like hæmocyanin and chlorocruorin seemed to us very significant, and suggested that this pigment was the predicted high-molecular hæmoglobin-like protein. An ultra-centrifugal study has fully confirmed this supposition.

Blood from *Arenicola marina* which had been kept in ice for about two days was diluted with a 1 per cent solution of sodium chloride and the sedimentation velocity of the molecules measured at 20°. It was found to be beautifully homogeneous with regard to molecular mass, and gave a sedimentation constant of 60×10^{-13}. This is not far from the value of the sedimentation constant of *Octopus* hæmocyanin, namely, 45×10^{-13}, and from that of *Helix* hæmocyanin, namely, 98×10^{-13}, but is of quite a different order of magnitude from the sedimentation constant of the vertebrate hæmoglobin, which is $4{\cdot}4 \times 10^{-13}$. The molecular weight of the blood pigment of *Arenicola* is therefore of the order of millions.

For the sake of comparison, a determination was also made with blood from *Lumbricus* collected immediately before beginning the run. The sedimentation constant of the respiratory pigment was found to be 68×10^{-13}. It is possible that the *Arenicola* blood used for the determination of the sedimentation constant may have decomposed slightly during the time between collecting and centrifuging it, and that therefore the value of the sedimentation constant of quite

fresh *Arenicola* blood is somewhat higher. But even if allowance be made for this slight uncertainty, we believe that there remains a real although small difference between the sedimentation constants of the blood pigments of *Arenicola* and *Lumbricus*.

The fact that not only the hæmocyanins but also other respiratory pigments in the blood of the lower animals have molecules of enormous mass seems to us very remarkable. It would be of considerable interest to try to find out at what stage of evolution the normal hæmoglobin appears, and whether its existence is exclusively connected with the formation of blood corpuscles. Perhaps hæmoglobin with its comparatively low molecular weight is strictly limited to the blood of the vertebrates, and the very high molecular weight respiratory pigments to the blood of the invertebrates. A study of the molecular weights or the sedimentation constants of the blood pigments throughout the animal kingdom might serve to throw light upon the relationships of the various classes of animals and upon their relative age.

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July 30.

[1] *Proc. Roy. Soc.*, B, **96**, 28; 1924.

The Limiting Mobilities of some Monovalent Ions and the Dissociation Constant of Acetic Acid at 25°

MACINNES, Shedlovsky, and Longsworth [1] claim to have obtained accurate figures for the limiting mobilities of certain monovalent ions, *inter alia*, K^+, 73·50; Na^+, 50·10; H^+, 349·72; Cl^-, 76·32; CH_3COO^-, 40·87; and they refer to the discrepancies between these and the older figures compiled by Noyes and Falk.[2] We would point out that all these constants, except that for the acetate, were determined by us some time ago,[3] and were based on the use of the Ferguson and Vogel method [4] for extrapolation to infinite dilution and a value of 0·490 for the cation transport number for potassium chloride; our figures are K^+, 73·4; Na^+, 49·8; H^+, 348·0; Cl^-, 76·4, that for the hydrogen ion being based on conductivity measurements of iodic, hydrochloric, and benzenesulphonic acids in dilute solution in silica cells.

We have recently carried out conductivity measurements on sodium and potassium acetates and have corrected the results for hydrolysis by a method which is of general application; our figure for the mobility of the acetate ion is 37·85. New determinations of the conductivity of acetic acid over the concentration range $0{\cdot}0001 - 0{\cdot}01N$ in silica cells of the Hartley and Barrett type gave the value of $1{\cdot}776 \times 10^{-5}$ for the true or thermodynamic dissociation constant of this acid. This is much higher than the figure $1{\cdot}753 \times 10^{-5}$ obtained by MacInnes and Shedlovsky.[5] Full details of these results will be published in the near future.

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G. H. JEFFERY.

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Aug. 27.

[1] *J. Amer. Chem. Soc.*, **54**, 2761; 1932.
[2] *J. Amer. Chem. Soc.*, **34**, 454; 1912.
[3] *J. Chem. Soc.*, 1715; 1931: 400; 1932.
[4] *Phil. Mag.*, **50**, 971; 1925.
[5] *J. Amer. Chem. Soc.*, **54**, 1429; 1932.

Structure of Polished Solids

IN consequence of the recent communication of R. C. French [1] on the structure of polished surfaces—investigated by high-speed electrons—and the fact that at the same time W. Boas and E. Schmid,[2] using Laue reflection diagrams, come to rather different conclusions, it seems desirable to mention some of the results, obtained on different experimental lines and published in Holland about a year ago.[3] These latter results suggest that polishing should be considered primarily as a very fine process of abrasion of the suitably prepared surface, accompanied by a levelling of surface lamellæ (or micellæ), the first step in this direction already being made when grinding the specimen (plastic deformation in the surface layers).

Delicate polishing leads, *inter alia*, to a dragging of minute particles along from the surface, the size of the detached aggregates of atoms ranging mainly in the case of most common hard metals at room temperature from about three to about thirty atoms.[4] Now it is well known that, in the region of dimensions of this size, the properties of aggregates show an exceedingly large variation with particle size. One must therefore consider the process which yields such aggregates—in spite of their very small dimensions—as still being essentially different from a 'molecular' process.

The amicrons [5] concerned may be made discernible ultramicroscopically by means of suitable physical development (Daguerre, Houllevigue, Stern, etc.). A part of the originally detached particles, however, fills up existing pits in the surface and recombines with it (by a process of adhesion, as well established in previous work of the late Sir G. Beilby). The mechanism of polishing always occasions the formation of a surface film ('skin') which largely differs in properties from the underlying material ('core').

The polishing of glass meets with a complication as a consequence of the presence of a eutectic rich in alkali embedded in a framework rich in silica. The soft alkali is the more easily removed part; [6] moreover, that part of the detached particles which is richest in silica—being chemically inactive and fitting easily into the surface pits—adheres best to the surface. In this way a more resistant form of surface-film may be produced.

According to H. Zocher and K. Coper,[7] even such delicate working as the one-directional rubbing of a very hard body, such as quartz, with, for example, a piece of cotton wool, gives rise to a surface anisotropy, as a consequence of deformation, ranging to depths below the surface which are large in comparison with molecular dimensions. Heating may occasion a disappearance of the surface anisotropy, depending on the time of heating and the maximum temperature applied, in a way which agrees with general rules as already given some time ago by W. Reinders and L. Hamburger,[8] who investigated the microscopical, ultramicroscopical, and electrical behaviour (resistance) of thin metal and salt films under varying conditions of film thickness, film backing, mode of preparation, temperature, effect of catalysts and chemical agents.[9]

The carefully polished surface films of crystalline materials—prepared and kept at a temperature far below the melting point—consist of lamellæ of levelled crystallites of non-microscopic dimensions which show a frequency distribution of particle size. These films ordinarily pass into the core material via a transition layer of relatively great thickness, along which the structure and texture show a *continuous* change.[10] The nature of polished surfaces is, more-

over, complicated as a consequence of its general physical metastability;[11] further, through the adsorption of foreign substances, the occasional occurrence of embedded abrasives (rouge, etc.), and the presence of more or less disturbed boundaries of contact between the minute particles. The importance of the latter factor is, of course, more pronounced than in the case of relatively coarse-grained materials, where the intergranular surface of contact is only a relatively small one.[12]

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July 21.

[1] NATURE, **129**, 160; 1932.
[2] *Naturwiss.*, **20**, 416; 1932.
[3] L. Hamburger, *De Ingenieur*, **46**, W, 91-98; 1931.
[4] L. Hamburger, Paper read before the Colloid Section of the Netherl. Chem. Ver. at the meeting of May 28, 1932; in print.
[5] See R. Zsigmondy, "Zur Erkenntnis der Kolloide", p. 87; 1905.
[6] L. Hamburger, *Proc. Kon. Ak. v. Wet. Amsterdam*, **21**, 1066; 1918. T. Haigh, Report Brit. Sci. Instr. Res. Ass. 1921; J. W. French, NATURE, **110**, 97; 1922.
[7] *Z. phys. Chem.*, **132**, 295; 1928.
[8] *Proc. Kon. Ak. v. Wet. Amsterdam*, 1916, 1917.
[9] See also *Rec. d. Trav. chim. des Pays-Bas* (4), **12**, 351, 441, 475; 1931.
[10] In case of more severe forms of cold-working, complications occur. See W. G. Burgers, *Z. Phys.*, **58**, 11; 1929.
[11] Spring, 1903; E. Cohen, 1910.
[12] See L. Hamburger, *Ann. d. Phys.* (5), **10**, 789, 905; 1931: **11**, 40; 1931.

Mechanism of the Action of X-Rays on Living Tissues

CHEMICALLY, nothing definite has been known on the action of X-rays. This lack of knowledge has led to their use where the benefits of X-irradiation are problematic. X-ray dosages, too, must be set empirically owing to inability to measure in any way their immediate effect on the cells. Even after waiting a week or ten days, only the gross effects can be determined.

From certain theoretical physical considerations based upon cellular oxidations and reductions of the redox type, it occurred to me that, when tissue was irradiated with X- or γ-rays, a definite amount of hydrogen should be evolved. This hydrogen should be rapidly diffused through the tissue walls, and thus could be measured.

A detailed explanation of the hypothetical assumptions made previous to this experiment will follow as soon as certain quantitative data are available. Such data, I hope, will give a criterion for determining the advisability of using X-rays, as well as definite information on which to base the dosage.

In this experiment a micro-respirometer was constructed, having by far the greater volume of air space concentrated in the middle of a tube. On either side of this air space stop-cocks were placed so that the whole could be dismounted for analysis. The respirometer was used to make sure that the tissues employed were alive, and air was used throughout. In the first case, a small piece (about 0·25 c.c.) of normal human rectus abdominus muscle was placed in Ringer's solution, and irradiated in the respirometer for 45 minutes with X-rays. A tungsten target and a dosage of 90,000 r. units (20 ma. 75 kv.) were used. The gases in the respirometer were then analysed and found to contain 1·6 per cent hydrogen, by volume. In the second and third cases, primary carcinoma of the breast were used, and 1·03 and 1·27 per cent hydrogen were evolved respectively. In the fourth case, primary carcinoma of the rectum showed 0·83 per cent hydrogen. The experimental error in the determination of hydrogen was less than 0·05 per cent by volume. As the volume of gas contained in the micro-respirometer was approximately 150 c.c., 1 per cent hydrogen would be equivalent to 1·5 c.c.

The amount of tissue used in each case was of the same order of size, but was not weighed or measured, as the important preliminary consideration was to establish the fact that both normal and pathological tissues actually gave off hydrogen during X-irradiation. γ-Rays were not used, but should have a similar effect. Controls were then run as follows: (1) the empty respirometer was irradiated to determine whether any hydrogen was given off from the glass; (2) Ringer's solution was irradiated; (3) and (4) normal and pathological tissue were allowed to respire freely. The gases in each case were then analysed. All the controls were found to be negative for hydrogen. Of course sodium hydroxide was used to absorb the carbon dioxide produced. This was irradiated in (2) above.

The tissues were all killed after about 25,000 r. units. A control was run on muscle tissue that had been killed by asphyxiation, and no hydrogen was evolved after a dose of 90,000 r. units had been used. This, of course, is significant, inasmuch as the hydrogen comes only from the living tissues. Later quantitative measurement, using normal and pathological tissues from the same area, should prove especially enlightening in view of the relative rates of metabolism. The effect of smaller doses of X-rays, and ascertaining which wave-lengths give the maximum effects, should aid in determining exact X-ray dosages.

The fact that hydrogen is removed from the scene of action in tissue metabolism, I believe, is largely responsible for the killing, or at least reducing, the vitality of the cells. Just how this affects them can probably best be shown through oxidation relationships. This will be discussed in a later paper. Regardless of the precise method of evolution of hydrogen, the fact remains that it does come from somewhere within the tissues.

I wish to express my indebtedness to Dr. N. Rachevsky for his continued help throughout this work, to N. A. Ziegler for making the hydrogen analyses, and to George V. Le Roy for certain physiological data resulting in this experiment. (Preliminary Report.)

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Radiographs of Insects

FINDING no record that radiographs of insects were ever made, last summer we took several hundred radiographs of some forty different species of insects. The X-ray tube, constructed in the laboratory, was of lithium glass, and furnished with a very thin window allowing rays of sufficient softness to be used. 3500 volts was the lowest potential with which this tube could be run, and with this potential the venation of wings was shown very distinctly. During the whole work, potentials ranging from this lower limit to 15,000 volts have been used, according to the size of the insect. The insect was placed directly on the photographic film, which was of the type manufactured by the Eastman Kodak Company for dental work.

As an example of the type of radiographs obtained, a reproduction of one showing a *Hydropsyche* larva is given in Fig. 1.[1] The coiled structure is the Malpighian tubules, while the long, narrow, longitudinal

bands are the silk glands. The Malpighian tubules are shown pure white, indicating that they contain chemical elements of comparatively high atomic weight. Excretion of ingested inorganic salts may be indicated, inasmuch as radiographs of different specimens show various degrees of opacity, from no delineation to complete whiteness of the image.

The digestive system and the tracheal tubes are usually the most pronounced structures seen in the

FIG. 1.—Radiograph of *Hydropsyche* larva. ×3.

radiographs. The digestive tract often contains opaque food matter. In insects having a complicated digestive tract, such as the cricket, the detailed structure of the fore and hind gut stands out distinctly. The musculature and the architecture of the chitinous exoskeleton are well brought out. The fat body often exhibits a granular structure, due presumably to the storage of insoluble excretory products containing a chemical element of comparatively high atomic weight. The reproductive organs are not shown well, except that the male accessory reproductive apparatus and, occasionally, the testes themselves and their ducts are visible (water strider). The venation may be brought out beautifully. As an aid to morphological work in the classification of insects, certain details may be brought out which would obviate the dissection of the insect. An important usage may be in physiological studies, especially of digestion and excretion.

We have received invaluable assistance from Dr. S. I. Kornhauser, of the University of Louisville, during this work, for which we express our gratitude.

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[1] Other reproductions of our radiographs will be found in the September-October number of *Radiography and Clinical Photography*, published by the Eastman Kodak Company.

Petroleum Bacteria and the Nutrition of *Psilopa petrolei*

IN a recent letter to NATURE,[1] Messrs. Lipman and Greenberg have described a coccus or cocco-bacillus occurring in petroleum obtained from a Californian oil well 8700 ft. in depth, and have stated that it has the power of oxidising petroleum with the production of carbon dioxide. This is an interesting addition to the list of micro-organisms which have been recorded as capable of decomposing paraffin hydrocarbons.[2]

The record is, however, of particular interest by reason of its possible connexion with the nutrition of the petroleum fly, *Psilopa petrolei* (Diptera, Ephydridæ). In 1930, I published[3] an account of the biology of this extraordinary insect, in which I described and illustrated the mid and hind gut of the larva as containing great numbers of a cocco-bacillus. My experiments showed that the fly larvæ, which had previously been supposed to feed on the paraffin itself, were unable to go through their development in the absence of extraneous animal matter such as the bodies of small insects; these being frequently trapped in the pools of crude oil where the larvæ live. The experiments did not, however, prove that the larvæ were incapable of deriving *any* nourishment from the oil, which is constantly swallowed, and it was indeed suggested that the bacteria in the proctodæum might be concerned in nutrition, either serving directly as food or by the production of some available substance from the petroleum. This hypothesis appeared all the more probable in view of the great abundance of larvæ in some of the pools contrasted with the apparent scarcity of trapped insects which could be used as food.

In 1931, I obtained some specimens of oil from the Santa Fe Oil Field of southern California, some samples being taken from exposed oil pools, others direct from the wells. These specimens were kindly examined by Mr. J. H. V. Charles of the Division of Biochemistry of the London School of Hygiene and Tropical Medicine. Large numbers of bacteria-like bodies were observed in all samples, although more abundant in those from the exposed pools. First attempts to culture these organisms in pure paraffin hydrocarbons were unsuccessful, but it has now been found possible to grow them in Söhngen's hydrocarbon-ammonium chloride medium at 32° C. The organism first obtained differs from that found in the alimentary canal of *Psilopa*, and from that described by Lipman and Greenberg, in that the bodies are rod-shaped (or fusiform) rather than cocco-bacillary in form. However, Mr. Charles now informs me that, after continued incubation, the cultures show numerous bodies cocco-bacillary in form and exactly similar in appearance to the organism found in the gut of *Psilopa*, although the original larger fusiform bodies are still present in abundance. As yet, nothing has been ascertained as to the metabolism of these bacteria, but work on the subject is being continued, and it is hoped that before long some knowledge as to their mode of life will be forthcoming.

It appears that such organisms are by no means universally present in natural oils, although, according to Söhngen, organisms (bacterium, mycobacterium, micrococcus) capable of oxidising paraffin are easily obtainable from soil. While in Trinidad recently, I obtained a number of fresh petroleum samples from oil wells of varying depth in the neighbourhood of Apex, San Fernando, but in no case were any bacteria or other organisms found.

The abundance of micro-organisms in Californian oil fields may conceivably have some connexion with the ability of an insect to colonise this particular environment—an achievement, so far as is known, unparalleled elsewhere.

W. H. THORPE.

Zoological Laboratory,
Cambridge,
Aug. 23.

[1] 129, 204, Feb. 6, 1932.

[2] See Söhngen, N. L., 1913, "Benzin, Petroleum, Paraffinol und Paraffin als Kohlenstoff- und Energiequelle für Mikroben", *Centbl. Bakt.*, 37, 595-608, and Tausz, J., and Peter, M., 1919, "Neue Methode der Kohlenwasserstoffanalyse mit Hilfe von Bakterien", *Centbl. Bakt.*, 49, 497-554.

[3] Thorpe, W. H., "The Biology of the Petroleum Fly, *Psilopa petrolei*". *Trans. Entom. Soc. Lond.*, 78, 331-344; 1930.

Diffraction of Electrons in Mercury Vapour

Two years ago, while investigating the angular scattering of electrons in mercury vapour, I found well-marked diffraction effects.[1] In that investigation, results were obtained over an angular range of 18°-126°, and for velocities of the primary electron beam between 8 volts and 800 volts. It was later announced that the work was being extended to larger angles and to other vapours.[2] The apparatus has now been modified to enable results to be obtained for angles up to 175°.

In Fig. 1 some typical results for mercury vapour are shown. An interesting feature of the new results

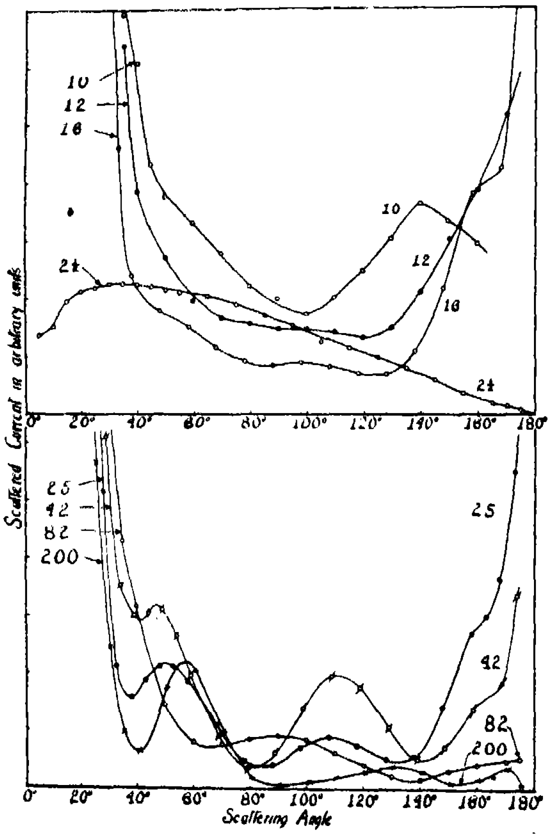

FIG. 1.

is the strong backward scattering of electrons having energies between about 50 volts and 10 volts. This feature has also been found to occur in the rare gases by Ramsauer and Kollath,[3] and in argon by Hughes and McMillen.[4]

In addition to the results given in Fig. 1, curves have been obtained for a number of intermediate voltages. As these curves merely show transition stages between the curves reproduced here, they have been omitted in this preliminary report. A full account of this work will be published shortly, and in the meantime other vapours will be investigated.

F. L. ARNOT.

University of St. Andrews,
Aug. 12.

[1] F. L. Arnot, *Proc. Roy. Soc.*, A, **130**, 655; 1931.
[2] F. L. Arnot, *Proc. Roy. Soc.*, A, **133**, 615; 1931.
[3] Ramsauer and Kollath, *Ann. d. Phys.*, **12**, 837; 1932.
[4] Hughes and McMillen, *Phys. Rev.*, **39**, 585; 1932.

Sir Richard Threlfall and the Automatic Microtome

THE appreciative notices of Sir Richard Threlfall which have appeared in NATURE have made no reference to what was probably his first notable invention;—and one that revolutionised an essential method of biological research. As a contemporary of his at Cambridge, among the first who had the opportunity of profiting by his results, I may perhaps be permitted to emphasise its importance. It had been realised for some time that the structure of an animal could be studied with great advantage with the aid of a complete series of sections arranged in order on microscopical slides. Until 1883 no satisfactory method was known of preparing and mounting such a series. Each section had to be separately placed on the slide, where the material in which it had been embedded was dissolved. Parts of the section which were not connected with others floated away and were lost; and the sections already in place were disarranged, involving the necessity of readjusting many of them before the next section could be added. The work involved was extremely laborious, as I can state from personal experience, and the final result left much to be desired. These were, however, the methods with the aid of which F. M. Balfour established his reputation as an embryologist.

The credit of initiating a more satisfactory process is due to W. H. Caldwell, who ascertained that a section of an object embedded in a block of solid paraffin cut so that two of its edges were parallel to one another and to the edge of the knife to be used could be made to remain united on the razor. An important detail in this method was that the block of hard paraffin used for embedding was dipped, before cutting, in a paraffin of lower melting point, which served as the cement uniting consecutive sections. In 1882, Caldwell consulted Threlfall, then an undergraduate at his own College (Caius), leaving it to him to devise a machine which would produce the desired result. This object was duly accomplished; and the microtome, constructed in Prof. Stuart's workshop at Cambridge at Threlfall's expense, was completed in 1883 and proved an unqualified success. Its history has fortunately been recorded in a very recent paper by Threlfall (*Biological Reviews*, Cambridge, vol. 5, p. 357; 1930), who stated that the only biological work he ever did at Cambridge was the preparation, with his microtome, of a complete series of sections of *Amphioxus*, represented (in part) by a ribbon of sections "some yards long".

The original instrument continued in almost daily use in Sedgwick's laboratory at Cambridge for many years after newer patterns had been invented, giving results equal to those of the best of them; and I think I am right in stating that it was still employed when I left Cambridge in 1908. Threlfall had added one essential improvement to Caldwell's original idea. This was the introduction of a method by which the sections were arranged on slides coated with a dilute solution of rubber, by which they became attached to the slide, so that the paraffin could be dissolved without disturbing any of the loose parts. Slides containing sections prepared by the method of Caldwell and Threlfall can be read like the consecutive pages of a book, instead of, as previously, like an incomplete series of detached pages frequently imperfect and out of order. Biological science has to acknowledge a deep debt of gratitude to Threlfall for designing the first automatic microtome.

SIDNEY F. HARMER.

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Sept. 7.

Research Items

Tobacco among Californian Indians.—Knowledge of tobacco and the practice in its use among the Karuk Indians of the Klamath River, California, are recorded, for the most part in their own words, by Mr. J. P. Harrington in *Bull.* 94 of the Bureau of American Ethnology. Literature on this matter among Californian Indians is practically non-existent, and this is the first section of an inquiry among selected tribes in diversified areas of the State. Drake, in recording his visit to what is now presumed to be Drake's Bay, in 1579, mentions "bagges of Tóbah for presents" brought by the Indians. This was *Nicotiana bigelovii* var. *exaltata*, the species now used by the Karuk. The Pomo Indians use *N. glauca*, introduced from South America. Both species now grow wild in this region. Before the restriction of their activities by the whites, the Karuk were typical river Indians, living on rancheros, their food being acorn soup, salmon, deer meat, greens, berries, nuts, and vegetables. Tobacco was cultivated in a simple fashion. In curing, leaf and stems were separated, the latter being pounded to form an inferior kind of tobacco which was used by hunters, priests of ceremony, and doctors as offerings to the Ikxarey, the 'old-time people', who turned into animals, plants, rocks, mountains, and the like, when the Karuk came to the country, and after they had started all customs. The superior tobacco is smoked by men. Women never smoke except when, as doctors, they perform the functions of men. Tobacco is used only for smoking, being chewed only rarely, and never eaten. The pipe is made of wood with a soapstone lining to the bowl, and is sometimes inlaid with abalone. Smoking is practised in the evening only, after the meal. Tobacco-smoke blowing and tobacco tossing accompany all ceremonies and actions in which luck is sought. The thought of the Karuk is so occupied with tobacco, that it enters into the names of places and individuals.

American Prehistoric Basketry.—An attempt to classify the prehistoric basketry of the south-western United States has been made by Gene Weltfish (*Smithsonian Misc. Collec.*, vol. 87, No. 7), notwithstanding the unevenness of the material and the indefinite character of the information relating to some of it. After examination of all the material available from the various sites in the south-western area and its arrangement in accordance with the archæological classification of south-western cultures, it is concluded, in general terms, that certain technical types stand out clearly. In *coiling*, there are three types with triangular foundation elements: basket-maker in two varieties—two-rod-and-bundle-triangular, and two-rod-and-reed-triangular; cliff-dwellers (identical with basket-makers in type, but differing in texture); and a type with three-rod-triangular foundation. One-rod foundation with interlocking stitches occurs with sufficient frequency to be called a type. In sifter coiling there are two types; and in twill plaiting there are two types, the yucca ring baskets being made from the centre of the bottom upwards, and a second form made downwards with the bottom unfinished. The most important implication of the classification is that there appears to be strong evidence of a unified San Juan area in which basket-maker material is concentrated, with more divergent types at the periphery, and one-rod and sifter coiling as perhaps intrusive. The outstanding cliff-dweller types are the close coiled basketry of basket-maker type and the yucca-ring baskets, the latter persisting in modern times at Hopi and Rio Grande Pueblos. The three-rod-triangular foundation is independent of the basket-maker-cliff-dweller complex and may belong to a later horizon. It is identical with the modern coiled basketry of the San Carlos Apaches. The close affiliation of Sikyatki with modern Hopi is supported by basketry evidence. The appearance of a distinct Texas type of coiled basketry south of the Lower Rio Grande probably marks the limit of the prehistoric south-western area.

Helminthes in Man in Rhodesia.—In a helminthological survey of Southern Rhodesia, Dr. W. K. Blackie (No. 5, Memoirs, London School of Hygiene and Tropical Medicine, 1932) records the results of observations made in the Colony in 1930-31. The incidence of helminthic infestations was ascertained by examining both indigenous and immigrant natives and, later, the European sections of the community. Dr. Blackie gives details of the incidence of *Schistosoma hæmatobium* and *S. mansoni* and of the distribution and biology of their respective molluscan intermediate hosts, and records the finding in man (ten cases) of *S. mattheei*, a species described in 1929 from sheep in South Africa, and found by the author in sheep and cattle and in one baboon in Southern Rhodesia. The definitive site of this species in man is the bladder, and the eggs are passed in the urine. Hookworm infestations are present among all sections of the population. The nematode *Ternidens deminutus* was found in about one hundred natives, and an examination of monkeys and baboons along the eastern border of the Colony revealed a high incidence of infection with this worm. The occurrence of *Strongyloides fulleborni* in twenty-four cases appears to be the first record of the natural occurrence of this worm in man. The author concludes that schistosomiasis (especially urinary) is the most important helminthic disease in the Colony and that next in importance are the hookworm infestations.

Improved Anti-Plague Serum.—It was noted in the Report for 1929 of the Haffkine Institute, Bombay, that experimental evidence had been obtained that anti-plague serum prepared by the immunisation of the ox and sheep is more potent curatively than that prepared in the horse. In the Report for 1930 it is stated that an important trial of this new serum on human cases under carefully controlled conditions has been carried out, with encouraging results. Of 43 cases of plague treated with the serum, 15 died, while of 33 similar cases treated on identical lines but without serum, 23 died. In the first series, the recovery of cases with a considerable number of plague bacilli in the blood was noteworthy, and the rapid improvement of others within a few hours of serum treatment was striking.

New West Indian Molluscs.—During an exploration of certain parts of Hispaniola in 1931, Dr. Alexander Wetmore collected a quart bag full of scrapings from under the edges of stones and such-like places on the small island of Beata. The casual collection has proved to be of unusual interest, for in it Paul Bartsch has discovered an amazing number of new land molluscs. The island itself is about 4½ miles long by 4 miles wide, and is formed of much-eroded limestone, densely covered in some places by scrub and cacti. The rubbish collected for shells was obtained along a quarter of a mile bordering the trail going inland from the north shore (*Proc. U.S. Nat. Mus.*, vol. 81, art. 6; 1932). Out of 16 species represented in the collection, the author describes 13 new species, 1 new sub-species, and 1 new sub-genus (*Chrondropomella*). The affinities

of the forms described and figured are distinctly Haitian, but all are so strikingly differentiated that it is safe to believe that Beata Island has for a long time been separated from the larger island. Yet it is only six miles off Beata Point, the southern extremity of Haiti, with which it is connected by a submarine bank at a depth of 12-18 feet below the surface.

Mosaic Disease of the Tomato.—Much confusion about the terms 'streak', 'stripe', and 'mosaic' in relation to tomato diseases must have existed in the minds of market growers. It has been suggested that *Bacillus lathyri* can cause stripe, and that this malady is accentuated by the absence of potash fertiliser in the soil. A short paper by Mr. G. C. Ainsworth in the seventeenth annual report of the Cheshunt Experimental and Research Station, 1931, makes clear the relationship of the three diseases. Mosaic is caused by a virus; streak by a mixture of mosaic and another potato virus. Inoculations from striped plants almost invariably gave mosaic symptoms, and it looks as though the virus has considerable causal connexion with stripe. Progress reports on "Physiological Investigations of Mosaic Disease" are also given in the same publication by Messrs. W. H. Read and B. D. Bolas.

Northern Land.—Some discoveries regarding the little-known Northern Land, or Severnaya Zemlya (formerly Nicholas Land), are given in the *Polar Record* for July. They are the result of the Soviet Union expedition that has been wintering at the observatory on the Serge Kamenev Islands to the west of Northern Land. Extensive sledge journeys prove that Northern Land consists really of three large islands and many small ones. Komsomoletz, the most northern, has an area of 3610 sq. miles and reaches to lat. 81° 16′ N. The narrow Red Army Strait separates it from October Revolution Island (5510 sq. miles), which in its turn is divided from Bolshevik Island (3420 sq. miles) by Schokalski Strait. The expedition worked chiefly on the two northern islands, both of which are mainly lofty and dome-shaped with receding ice-sheets that cover about eighty per cent of the area. These sheets are said to be the remains of a Quaternary sheet which enveloped all the islands and the Taimir Peninsula. Round the edges of the present ice-sheets several nunataks were noticed. Stagnant valley glaciers occur. Northern Land appears to be part of the same post-Permian foldings that are represented in the Taimir Peninsula. Its present outlines are due to a series of Quaternary faults. On the lower western sides there are still faults approximately in a meridional direction. There seems to be a general elevation of the land in progress. The expedition is continuing its work.

Recent Displacements of the Earth's Crust in Japan.—The repeated levellings carried over certain districts in Japan show that crustal movements have been taking place recently, some of them in connexion with great earthquakes, others in regions within which no earthquake has occurred for many years. Prof. C. Tsuboi contributes the fourth of his valuable memoirs on the deformation of the crust with and after the Tango earthquake of 1927 (*Earthq. Res. Inst. Bull.*, vol. 10, pp. 411-431; 1932). In this, he considers the displacements of 226 triangulation points of the third order, in addition to 6 of the first and 41 of the second orders. The complete map closely resembles one already reproduced in NATURE (vol. 126, p. 923), except that it covers a much larger area. Prof. Tsuboi also gives a number of maps representing the displacements in various ways. Of these, one of the most interesting is that showing the principal axes of the strain ellipses. These have very large values of ellipticity along two zones at right angles to one another and coinciding with the Gomura and Yamada faults produced at the time of the earthquake of 1927. The author concludes that the Gomura fault was due to a contracting movement and the Yamada fault to a shearing movement of the earth's crust. Another article communicated by the Institute (pp. 490-491) shows the changes of level along the south coast of the main island of Japan, the route surveyed in 1889–1900 and again in 1931 being 330 miles in length from Okitu to Kusimoto. The principal results are a depression of the west coast of Suruga Bay amounting to 7·5 in., to the west of the bay an elevation reaching 10·8 in. north of the Bay of Atumi, succeeded by depressions of 9·3 and 8·5 in. at the head of the Bay of Ise, which lies a short distance to the south of the central area of the great Mino-Owari earthquake of 1891.

Oil and Gas in Eastern Canada.—Four years have elapsed since the publication of G. S. Hume's account of oil and gas in the west of Canada, and there has just appeared, by the same author, a complementary report on eastern developments (Canada, Department of Mines, Econ. Geol. Series No. 9, 1932). The staying power of these eastern fields has been, and is, remarkable. One has only to refer back to F. G. Clapp's composite memoir on the petroleum and natural gas resources of Canada, published in 1915, to appreciate this. Seventy years ago the first well was drilled on Black Creek, the present site of Oil Springs Field, Lambton County, Ontario, and the discovery of the Petrolia Field followed soon afterwards; to-day, in spite of numerous other 'finds' in this region, these two fields still maintain their supremacy. It is gratifying to note that Ontario still encourages, by successful results, exploration for natural gas, for which product it has a long and enviable record. Stony Creek Field, near Moncton, New Brunswick, is the only oil and gas producing area east of Ontario, and its intensive geological study is being undertaken to provide new light on possibilities in other parts of this province and Nova Scotia.

Relative Abundance of Oxygen and Nitrogen Isotopes.—The discovery of rare isotopes of oxygen and nitrogen from band-spectra has been followed by several investigations of their abundance, with discordant results. In the second July number of the *Physical Review* a careful study of this question is reported by G. M. Murphy and H. C. Urey, on the basis of the absorption spectrum of nitric oxide obtained from a variety of sources. The method consisted essentially in a comparison of the concentrations of the two molecules $N^{15}O^{16}$ and $N^{14}O^{18}$, each of which contains one rare isotope and one common, and leads to a ratio of 350 : 1 for N^{14}/N^{15}. This is in good accord with chemical and mass-spectrograph data, but less than the best results obtained from emission spectra. The apparently erratic contributions of isotopes to the light emitted from a substance still remains an unsolved problem. In the present work, no difference was found in the isotopic composition of the nitrogen and oxygen from the different sources, of varying geological age.

Combustion of Hydrocarbons.—Prof. W. A. Bone's Bakerian Lecture (*Proc. Roy. Soc.*, August) was devoted mainly to a review of experiments on combustion of hydrocarbons, mostly already published, which bear on the nature of the compound formed initially between the hydrocarbon and oxygen. The problem has been to decide if this contains a hydroxyl group, or is some form of peroxide. Prof. Bone inclines strongly to the former view, which is supported by a great weight of qualitative and quantitative evidence,

particularly in the case of the slow combustion of ethane, where 36 per cent of ethyl alcohol has been isolated without a trace of peroxide. In cases where quantities of peroxide, usually small, have apparently been obtained amongst the products of reaction, Prof. Bone considers their identification not conclusive, and the evidence insufficient to prove that they were formed initially and not as further products from intermediate aldehydes. Prof. Bone does not however consider that 'peroxidation' may not occur in rather abnormal circumstances, saying in his summary that "In any case, even if eventually proved valid in particular cases or circumstances, 'peroxidation' can scarcely be regarded as being more than supplementary to 'hydroxylation', nor 'peroxide' as more than a side-product. In other words, it might possibly afford an explanation of 'knock' as an abnormal feature of hydrocarbon-air explosions, but scarcely of the normal course of oxidation therein." In another investigation, reported in the same issue of the *Proceedings*, C. Campbell, W. B. Littler, and C. Whitworth have succeeded in making an estimate of the pressure in explosion waves from the failure under impulsive shearing, induced by the waves, of copper foils the strength of which had been determined statically.

Calcium Equilibrium in Sea Water.—A drift of calcium away from cold polar waters and a concentration of calcium carbonate in the warm shoals of the tropics seems to be a feature of to-day. There is a probable undersaturation of sea water under some conditions and saturation to precipitation point under others. Bacteria are present in the deposits, and something is known of the physiological changes which these organisms can produce in the water. But what changes will produce a precipitate have never been established. The oceanographical aspects of this problem have long been the concern of Wayland Vaughan, who has initiated a full investigation at La Jolla under Haldane Gee, six papers of which are now published in the June *Bulletin of the Scripps Institute* under the title "Calcium Equilibrium in Sea Water". The theoretical considerations are summarised, and it is shown that tropical, shoal sea water should be approximately in equilibrium with solid calcium carbonate. At La Jolla the water may be slightly more than saturated with calcium when its temperature is raised to 27° C. Experimentally it is shown that calcium carbonate can be precipitated from raw sea water by reducing the total carbon dioxide content at a temperature of 28°-30° C., and ammonia tends to reduce its solubility for calcium. As experiments require long periods before approaching a stable state, rigorous conditions could only be established by eliminating all possible biological activity in the water, and this led to Gee's invention of a special apparatus, using Berkefeld filters, which is herein described. This proved successful, and calcium carbonate was precipitated aseptically from sea water under tropical conditions by reducing the total carbon dioxide content of the water. The precipitate was found to consist of needles of aragonite, practically identical in form, size, and optical properties with crystals of natural argonite from the calcareous bottom muds of the Bahamas.

Astronomical Topics

Faye's Comet.—A telegram from the I.A.U. Bureau, Copenhagen, announced the detection of this comet at Bergedorf. B.Z. No. 33 announces that the plate showing it was exposed for $2\frac{1}{2}$ hours by Dr. Wachmann, Dr. Guyot, and Dr. A. Schwassmann. The position on Aug. $30^d\ 0^h\ 37^m\ 12^s$ U.T. was: R.A. (1932·0) $0^h\ 27^m\ 1{\cdot}79^s$, N. Decl. 14° 53′ 32·5″, mag. 12·0. The perihelion passage will be about Dec. 5·68. The ephemeris in the B.A.A. Handbook may be used with the following corrections; Sept. $9 + 1^m\ 20^s + 4'$, Oct. $11 + 1^m\ 36^s + 6'$, Nov. $12 + 1^m\ 27^s + 4'$. As the comet is approaching the earth until Oct. 22, when its distance is 0·71 units, it is likely to brighten considerably. This is the eleventh observed apparition of the comet. It has only been missed at two returns, in 1903 and 1917.

Eleven comets have now been detected in 1932, but one of them (Carrasco) had perihelion in 1931, and two others (van Biesbroeck and Schmitt) were not observed sufficiently to receive permanent numbers.

The Reinmuth Planet, 1932 HA.—The following observations of this body, made by photography at the Union Observatory, Johannesburg, have come to hand; they are the only observations yet available from the southern hemisphere:

	R.A. (1932·0).	S. Decl.
1932 May 7·75017 U.T.	$12^h\ 6^m\ 22{\cdot}88^s$	10° 52′ 20·2″
7·76679	12 6 6·02	10 52 16·8

These, when compared with northern observations, indicate a parallactic displacement of more than 100″; this enables us to obtain a fairly exact estimate of the planet's distance from the earth, and hence of its period. This appears to be longer than the early determinations, and in the neighbourhood of 1·83 years, so that Eros, with its period of 1·76 years, is still the minor planet with the shortest period. If 1·83 years is correct, there will be a recurrence of configurations after 11 years, being 6 revolutions of the planet. There would in this case be a fairly close approach to the earth at the ascending node in the autumn of 1941, and one at the descending node in the spring of 1943. It will be difficult, but perhaps not impossible, to observe it earlier, as its distance from the earth will be considerable.

Forms of Spiral Nebulæ.—The spiral forms of the great nebulæ have engaged the attention of many mathematicians, but hitherto no completely satisfactory explanation has been reached. A recent paper by Mr. B. M. Peek (*Mon. Not. R.A.S.*, May) tries to explain them in terms of some simple assumptions. It is assumed that the nebula is rotating and contracting, so that the angular velocity increases, and at length matter begins to be shed at the rim, when the acceleration balances gravity. It is further assumed that the shedding begins at two opposite points, which are the points where the outward tidal action of external nebulæ is greatest. Once ejection has begun, it is shown that the tidal action of the ejected matter far exceeds external tidal action, and constrains the outer rim to move with the ejected matter.

Different laws for the rate of contraction of the nebula are tried; all give spiral forms for the outer matter, but the best approximation to observed nebulæ is found to be that the contraction varies as the cube of the radius. An extremely good approximation to the form of the nebula Messier 81 is worked out on this assumption. A point which causes Mr. Peek to have some doubt about his results is the shortness of the time-scale. He finds that the times required to reach about three convolutions are of the order of two hundred million years. A few years ago a time-scale of millions of millions of years was generally accepted; but considerations based on the expanding universe have diminished this a thousandfold. Mr. Peek gives one or two hints that may help to span the remainder of the gap. The spirals found by Mr. Peek are not equiangular; in most of them the inner whorls are more circular than the outer ones.

Greenland Hydroids

DR. P. L. KRAMP in two recent papers * discusses the hydroids of Greenland. The area investigated in the first is extensive, comprising the entire west coast of Greenland from Cape Farewell to Etah in the narrowest part of Smith Sound, and several series of stations laid from the Greenland coast across the Davis Strait and Baffin Bay as far west as possible; in several places the investigations being carried through to the coasts of Labrador.

The second paper deals with the hydroid fauna of representative fjords belonging to two groups, the so-called 'Atlantic' and 'Arctic' types. The difference between these two types is that in one the entrance is deep enough to allow the comparatively warm water of Atlantic origin in the deeper parts of the Davis Strait to come into the fjord, in which the bottom water, therefore, has a fairly high temperature. In the other, a threshold at the entrance prevents (or prevents for most of the year) the Atlantic water from entering the fjord, in which the bottom water is therefore very cold. North Strömfjord, investigated by Dr. V. Nordmann in 1911, was selected as the representative of the arctic type; and in the summer of 1912, Dr. K. Stephensen investigated Kvanefjord near Frederikshaab, Bredefjord, north of Julianehaab, and Skovfjord, six miles farther south, as representative of the Atlantic type.

It is an interesting fact that each zoogeographical group of species of hydroids has in all essentials the same bathymetrical distribution in both types of fjord, which agrees with the ascidian fauna as found by Hartmeyer. Stephensen found, however, that the crustaceans, pycnogonids, and echinoderms in North Strömfjord consist entirely of arctic and arctic-boreal species, whereas several boreal and Atlantic forms occur in the southern fjords. The only exception in the hydroids is that the abyssal Atlantic species are wanting in the North Strömfjord; otherwise in both types there are arctic, arctic-boreal, boreal, and cosmopolitan species in almost the same proportions at similar depths.

Species of all the zoogeographical groups, even boreal forms, were found at considerable depths and at low temperatures in North Strömfjord, but Dr. Kramp is of the opinion that the late summer and autumn temperatures in deep water rise to fairly high values. Stephensen and Hartmeyer emphasise the constantly negative temperature of the water at all depths from about 60 m. downwards, but Dr. Kramp observes that some hydroids are able to live for a long time under very unfavourable conditions of temperature if there is a short period when conditions are favourable. If the temperature rose sometimes to one or two degrees above zero, the presence of these boreal species would be quite explicable. On July 31, 1911, the bottom temperature at one of the stations near the entrance to the fjord at a depth of 170-200 m. was 1°-2°, and later in the year, according to Dr. Kramp, it will probably be higher, and this comparatively warm water will enter the fjord and mix with the other water layers, causing a rise in temperature for a time. As he suggests, the positive temperatures sometimes noted from these depths in Dr. Nordmann's journal, and considered erroneous, may not be altogether wrong, and there is no doubt that the violent currents cause a fair amount of mixing of the water layers. Thus the author explains the presence of some boreal species of both hydroids and ascidians which are able to propagate and grow at intermediate depths in North Strömfjord as due to the combined action of the influx of Atlantic water from the outside and of the vertical movements which bring down the surface water, heated during the summer, resulting in an increase of temperature in the deeper strata at certain periods of the year.

Dr. Kramp has also recently published "A Revision of the Medusæ belonging to the Family *Mitrocomidæ*". † As medusæ are of considerable use as indicators of sea-currents, it is important to be certain of the species with which we are dealing, and the memoir is very helpful in enabling us to distinguish the members of this family, at the first glance so similar to one another.

* Kramp, P. L. The Godthaab Expedition 1928. Hydroids. *Medd. om Grønland. Komm. for Vidensk. Undersøg. i Grønland.* Bd. 79, Nr. 1, 1932. Hydroids collected in West Greenland Fjords in 1911 and 1912, *ibid.*, Bd. 91, Nr. 3, 1932. (København: C.A. Reitzels Forlag.)

† Reprinted from Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening, vol. 92. Pp. 303-387. (København: Bianco Lunds Bogtrykkeri A.S., 1932.)

Megalithic Monuments of Brittany

IT was to be expected that megalithic monuments, and in particular circles, stone or other, would occupy much of the attention of the International Congress of Prehistoric and Protohistoric Sciences, recently held in London, especially as arrangements had been made to give many of the overseas members their first opportunity to view the site of the wooden circles at Woodhenge and 'The Sanctuary'. In fact, two whole sessions of Section III.A of the Congress were devoted to the subject. Among the communications then presented, special interest is attached to that of the veteran field archæologist, M. Z. Le Rouzic, whose prolonged and practical acquaintance with the problem of the megalith in Brittany gives him unquestioned authority on the subject chosen for his communication: "Morphologie et chronologie des monuments sépulchraux de Morbihan".

M. Le Rouzic classifies the megalithic monuments into ten groups as follows:

(1) Dolmens with rather irregular chambers and corbelling and an entrance passage roofed with small blocks; the whole is buried in a tumulus with a limiting circle of upright stones. Associated are polished axes, some small and votive, fine flint arrow-heads with barbs and stem, flint scrapers, borers, etc. The pottery is both fine and coarse; with these are pot spindle whorls and stone beads. An example is Parc Guren (Crac'h).

(2) Dolmens with long entrance passage and side chambers, built of large blocks. Also '*allées couvertes*' with port-holed supports. Corbelling is usually above large block-uprights. The monument is embedded in a cairn and often surmounted by a menhir. Uprights are often engraved. Associated are bell-beakers, 'bowls-with-support', beads of callais, etc., ornaments of hammered gold, as well as objects of Group 1. There are a few foreign types of fine flint work and copper or bronze daggers. Both burials and cremations are found—Kercado, Mané Lud, are good examples; also some '*allées couvertes*' of elbowed form (Le Pocher, Plougoumelen). Kerlescant '*allée couverte*' formerly had a port-hole. Île Longue is the finest corbelled tomb in Brittany.

(3) Tumulus with quadrangular cist, or cists of blocks or dry walling with hearths inside them. Purely neolithic associations. The second tumulus of

Le Manio contains 39 cists. There is a decorated menhir above it.

(4) Dolmens in a tumulus with contemporary cists. This is probably a combination of Nos. 1 or 2 with No. 3. No. 2 is probably an intrusive culture, No. 1 an impoverished local form of No. 2, and No. 3 either another local form based on No. 2 or an intrusive type of some other origin.

(5) Monuments containing a closed dolmenic chamber, often built with dry walling. (*a*) Yield fine jadeite, etc., axes, some very small and provided with suspension holes, ring-discs, many callais beads, but very little pottery; for example, Mt. St. Michel (Carnac) and Ker Lud. (*b*) Yield no callais but have arrowheads of translucent flint, copper or bronze daggers, halberds, and flat axes. The chamber is somewhat sunk; originally it had wood-covered walls. None of these monuments are found in the sacred Carnac region. They are probably the work of invaders or strangers. Examples are Mané-er-Loh, Mané Roullarde, Mané Kervilor.

(6) Tumulus enclosing a closed dolmenic chamber and stone cists (compare No. 4, but in this case a hybrid of 3 and 5), handled pots. The dating is early bronze age; examples are St. Germain, Erdeven.

(7) Tumulus with rectangular dry-walled cists. Associated are lances and blades of bronze. These are probably the poor successors of 5*b* and 3 crossed. Mané Rumentier is an example.

(8) Tumulus with six-slabbed cists. With these are bronze pins and black pottery. The dating is iron age; example, Mané Bekernoz.

(9) Tumulus with rectangular fossa in a circular enclosure with four-handled pots, objects in bronze and iron, and beads of blue glass. No. 7 at Le Rocher (Plougoumelen), Hallstatt and La Tène periods.

(10) True La Tène burials in subterranean chambers are found only in La Tène III.; for example, Kerfraral. To the same period belong tumuli with small entrance passages. They are often filled with black earth and charcoal and contain a hearth. Examples are Mané Roullarde, Mané Bras de Kervilor. No. 10 indicates the persistence of the influence of Nos. 1 and 2.

A second communication dealing with megalithic monuments in Brittany was presented by Prof. C. Daryll Forde on "The Typology of Megalithic Monuments in Brittany". Prof. Forde pointed out that Brittany contains a very complete range of megalithic and associated tombs from corbelled and rock-hewn chambers to small cists and coffers. The passage chamber is the basic form, and it is probably both relatively and absolutely most abundant in south Morbihan. It is usually truly megalithic. The Breton tombs show close parallels with the southern Iberian. The development of a multiple passage tomb in south Morbihan may have been the starting point for the rough grouped chambers found outside that region, and may have been the model for some of the tombs in the English long barrows.

Angled galleries and large closed chambers are specific Breton types, rare outside the peninsula, and mostly confined to the south. The covered gallery ('*allée couverte*'), in form, distribution, and some characteristic grave-goods, indicates connexions with north-east France; but its contemporaneity with other tombs is shown by the presence of the bell-beaker. A number of auxiliary grave types are associated with the larger tombs: small coffers of heaped stone fragments, stone cists, and trench graves. These are sometimes found under the same tumuli as megaliths without suggesting secondary interment.

The material from tombs of different type does not show much variation. While certain objects have a restricted geographical range, they are not confined to a single type of tomb. The concentration, fine construction, and abundance of Iberian parallels in southern Morbihan indicate that this was the first centre of megalithic construction in Brittany. The culture stagnated after the first diffusion, while the Armorican graves of the late bronze age show a very complete break with the tradition of the megalith builders.

British Phenology

THE Phenological Report, 1931, issued as a special number of vol. 58 of the *Quarterly Journal of the Royal Meteorological Society*, is the forty-first report of this kind. It deals primarily with variations in different parts of the country in the dates of the first appearance of certain birds and insects, of the first singing of various species of bird, and of the date of commencement of flowering under natural conditions of various plants of the country-side; it is consequently mainly in the form of statistical tables. Observers increased from 500 in 1930 to just over 600 for this issue, mainly as a result of broadcasting; while the south is well supplied with observers, there is still opportunity for more in the more remote areas, especially Wales, Scotland, and Ireland.

This particular number does not differ much in form from those for other recent years, although it contains a new feature in the form of a map showing what are described as average spring migrant isophenes—a system of lines of equal average date of arrival of twenty species of migratory bird based on records obtained during the seventeen years 1914–30. The dates are in the notation generally adopted in phenological work, that is, they are expressed as the serial number of the day in question, Jan. 1 being taken as 1, Feb. 1 as 32, and so on. Such a map of normal dates of arrival can be used when it is desired to know to what extent a particular year is abnormal in regard to the average time of arrival of migrants, and also may give information about the nature of bird migration to anyone capable of interpreting the figures; for example, the existence of closed areas of relatively late arrival superimposed upon a general retardation from south to north (the latter exceeding a fortnight as between southern England and northern Scotland), often corresponding roughly with elevation of the land, suggests a secondary feature of the migrational movement connected no doubt with the well-known backwardness of plant and insect development in higher and therefore colder localities, complicated by other factors if the lines are to be trusted.

A weather summary based on the published records of the Meteorological Office is included to enable the student to trace the effects of the weather upon the phenological records, and a table which appears for the first time in the present Report is Table I.D, showing the number of *weeks* with 'decided' and 'excessive' divergences of the three main weather elements, based on unpublished weekly weather returns. Table VI. includes *decade* means of the thirteen plants used in the records for comparison. The unique series of observations of trees and shrubs taken at St. Michael's, Tenbury, Worcestershire, in Table VII., and those of plants and birds taken at Hevingham, Norfolk, in Table XIV., are making their last appearance owing to death and infirmity.

The year 1931 was particularly interesting on account of the severe frosts in March and October, and much dull weather in the late summer.

Scientific Aid in Agriculture

THE story of the founding at Indore, in Central India, of an Institute of Plant Industry, its unique territorial associations and duties, the work in hand, and its bold, comprehensive policy of research has become widely known through the writings of its first director, Mr. Albert Howard. These have now been extended by articles in the *Empire Cotton Growing Review*, vol. 9, Nos. 2 and 3, 1932, entitled "The Improvement of Cotton Production". Plans are explained for dealing with specific cotton problems in Central India, but the articles also contain an important treatment of the general question of policy in agricultural research. During the past twelve months enforced economies have made responsible bodies all over the world scrutinise closely their disbursements on agricultural research. Some have inclined to grasp an excuse for ending scientific work with which they never sympathised, but the more common and the reasonable reaction has been to ask whether all the work in progress is well conceived and likely to benefit industry. Howard, speaking of the present position—a superabundance of raw cotton and low prices—asks if science can help the cotton industry under such conditions, and he bluntly adds that if it cannot "the days of agricultural research are indeed numbered".

Against agricultural research in general is laid the charge that practical problems have always been approached by one science at a time, working alone. This has imposed on research stations an inelastic organisation which, weakly following the strict departmentalism required for the teaching of the sciences, has produced rigid specialists and set them to attack isolated fragments, leaving major problems untouched. It is suggested that research must concern itself less with the details of existing agricultural methods and more with the possibility of evolving wholly new methods to meet the changes of situation which have swept over all branches of crop production. If cotton growing is to be substantially aided, the living plant must be the centre of action, and this can only be studied effectively in relation to the soil, the agricultural conditions, and the economic uses. Study of this kind, however, is not provided for by the accepted subdivisions of agricultural science. A new, broader outlook on agricultural problems is needed, with consequential changes in research organisation.

When he deals with "the improvements which really matter", Howard prescribes for cotton-growing improvement "a well-balanced combination of agronomy and genetics with soil science". Against insects and fungi the cultivation of suitable varieties in an efficient manner is urged as the only practicable method, and support is derived for this view from the history of the now famous sugar researches in Java.

Some of the minor points may be considered contentious and open to criticism, but the main thesis is an important statement on a great and urgent problem. To ask for attack on a wide front, for joint action by the various formal divisions of science, and that the structure of the industry itself should be added to the subjects for investigation, is to ask for no more than systematic planning of research, based upon careful reconnaissance of industry. Whether crop production can better be helped by inviting specialised branches of science to choose their own problems or by trying to resolve great practical problems into their scientific components and applying the sciences to these is the essential question these articles try to answer.

F. L. E.

Annual Exhibition of the Royal Photographic Society

THE seventy-seventh annual exhibition of the Royal Photographic Society was opened on Sept. 9 at the Society's house at 35 Russell Square, London, W.C. The exhibition will remain open each weekday until Oct. 8.

The Scientific and Technical Section this year, besides its usual features, possesses a notable series of photographs of the invisible. On one hand are some excellent examples of fluorescence photography of visually undecipherable documents. Here the invisible writing is shown by differential fluorescence of the parchment or paper surface when exposed to ultra-violet radiation. At the other end of the scale, photography by means of plates sensitive to the infra-red is shown in several aspects. First are many examples of long-distance photography through haze. Next are shown photographs taken in complete darkness, among them being photographs of hot flat-irons taken by their own invisible radiation. A very interesting example of the application of infra-red photography has been made in the examination of some rare old books in which certain passages were deleted some three hundred years ago by the censor for the Spanish Inquisition. The ink used for the deletions is, however, transparent to infra-red radiation, though the original printed characters are opaque; infra-red photography has thus been able to make tne original paragraphs easily legible. Infra-red photomicrography has been mentioned recently in these columns; some fine examples of this work are shown in the exhibition. Lastly, spectrograms are shown taken with plates sensitised with xenocyanine; by using this sensitiser many new lines have been recorded in the spectra of the rare gases between 8500 and 11,000 A.

Chemical engineers will be interested to find on view a working model of an electrolytic plant for the recovery of silver from used fixing baths. The exhibit represents part of a motion picture film laboratory in which millions of feet of film annually are developed, fixed, washed, and dried. In one of these factories the cost of the hypo fixing baths may easily exceed £2000 a year, and the unreduced silver bromide which is dissolved from the film may represent as much as £7000 worth of metallic silver, even at its present low price. Previously, the silver was salvaged by throwing it down as a sludge of silver sulphide, which had then to be treated by a somewhat costly refining process. The silver is obtained by the new process as 98 per cent pure metal on stainless steel cathodes. Fortunately, owing to an admixture of a small amount of gelatin, the deposit is very brittle, so that it can be readily scaled off from the cathodes. The hypo itself is regenerated by the electrolysis, and is run back into the fixing tanks for further service; owing to dilution and to the accumulation of soluble bromide, however, the solution would eventually become unfit for use; for this reason, about one-third of the desilvered solution is run to waste, and fresh hypo is added to the fixing baths. The total consumption of hypo is thus reduced to about one-third of the amount employed formerly.

In its other sections the exhibition maintains its customary high standard. The Colour Section, while not being large, contains some very fine examples of three-colour portraits. The examples of Press photography bear ample witness to the very high sensitivity obtained in certain new panchromatic materials.

University and Educational Intelligence

CAMBRIDGE.—Dr. Walter Langdon Brown has been appointed regius professor of physic in succession to Sir Humphry Rolleston, who retires on Sept. 30 on completion of his term of office.

Mr. J. O. Giršavičius, of Gonville and Caius College, has been elected to the Benn W. Levy research studentship in biochemistry.

LEEDS.—A series of sessional courses for teachers has been arranged to be held on Saturday mornings. The biology course will be divided into classes on the biology of the tree by Prof. J. H. Priestley and on the fundamental biology of animals by Mrs. A. Redman King. Mr. J. C. Gregory will give a course of lectures on elementary science, and Mr. W. P. Welpton on the teaching of mathematics. Although these courses are intended for teachers, particularly those in Senior Schools, other students may enter. Further information can be obtained from the Registrar.

A COURSE of lectures on television has been arranged to be given by Mr. J. J. Denton, secretary of the Television Society, in the Electrical Engineering Department of the Borough Polytechnic, Borough Road, London, S.E.1. The lectures will be given on Thursdays, commencing on Oct. 6. Further information can be obtained from the Principal.

A VACANCY exists for an assistant master at the Prince of Wales' Royal Indian Military College, Dehra Dun, United Provinces, India. The College was established in 1921 for the education of Indian boys in preparation for entry into Sandhurst and other military colleges and eventually for a military career as officers. The number of pupils at present in the College is 115. The normal age of entry is 11-13 years, and the course extends over six years. The assistant master appointed will be expected to teach science, especially physics. The starting salary varies from 550 to about 800 rupees a month according to age, and rises to 1500 rupees plus £30 a month (1 rupee = 1*s*. 9*d*.). These rates are, however, being subjected to a temporary reduction, not exceeding ten per cent, owing to the present state of financial stringency. Free quarters are provided, and the master appointed will receive an outfit allowance of £50 and free first-class passage to India. One of the assistant masters at the College is at present on leave in Great Britain and would be pleased to meet any intending candidates. Further information can be obtained from the Secretary, Military Department, India Office, London, S.W.1.

A "HISTORY of the Municipal University in the United States" has been published as a bulletin (No. 2 of 1932) of the Office of Education, Washington. The author, who is professor of the history of education in the Ohio State University, describes the origin and development of all those universities, eleven in number, which are directly under the control of municipal authorities. Universities which are municipal in this complete sense appear to be peculiar to the United States, where they represent an attempt to do for the citizens of the city what the State university does for the citizens of the State. Their emergence is regarded by the author as part and parcel of a great movement of increasing participation of public authorities in the provision and control of modern education, and as being an extension upward of the public school system of the city. Many of the newer universities in England and Germany, although not directly under the control of municipalities, are, like the American municipal universities, closely linked with them by mutual services, and owe their origin partly to a desire to provide educational opportunities for persons who would be unable to seek them elsewhere. In these and other institutions for advanced instruction and research where the work is closely related to local needs this historical survey will be read with interest.

Calendar of Geographical Exploration

Sept. 20, 1519.—First Circumnavigation of the Globe

Ferdinand Magellan sailed from San Lucar with a fleet of five ships under instructions to sail south by the coast of Brazil and thence to penetrate to the Moluccas. During their five months' stay at Port St. Julian, lat. 49° 20′ S., the Spaniards came into contact with Patagonian tribes and were struck by their tall stature. Sailing south, Cape Virgins was reached and the great discovery made; the passage through the strait was difficult and occupied 38 days, one ship deserting during the exploration. The trade winds carried the three vessels which passed the strait far from the Pacific islands, and in their nearly four months on the open sea the men suffered from hunger, thirst, and disease; nineteen died. Puka Puka in the Paumotu Archipelago was sighted on Jan. 24, 1521. Magellan was killed by natives on the island of Mactan on April 27, 1521. He had proved that the world was round, and had opened the way for the circumnavigation of the globe which was completed by Sebastian del Cano in the *Vittoria*, which reached San Lucar on Sept. 6, 1522, the only vessel of the five to return. Magellan left no record of his journey, and it was long before his remarkable feat of seamanship and endurance was recognised as one of the greatest events of exploration. He achieved the linking of western Europe with eastern Asia as a result of deliberate planning and first-class seamanship. By origin he was a Portuguese nobleman and his first voyages were undertaken for Portugal, but when he fell into disfavour with King Manuel he adopted Spanish nationality, and it was in the service of Charles V. of Spain that he made the voyage on which his fame rests.

Sept. 20, 1893.—Drift of the *Fram*

The *Fram* was frozen into the ice off the New Siberian Islands in 77° 30′ N., and drifted with the ice, on the whole in a north-westerly direction, reaching 85° 55′ N. in 66° 31′ E., the highest latitude ever reached by a ship. Nansen had convinced himself that there was a polar drift, and having planned the *Fram* to resist crushing in such a way that, if nipped in the ice, the opposing masses would pass under her and lift her to the surface, he deliberately committed her to the ice and awaited the results. The originality of the plan was only equalled by its daring: the party numbered 13 in all. After the second winter on the ice, when the northward movement seemed to be checked, Nansen and Lieut. H. Johansen left the ship in order to explore the regions towards the pole by travelling on ski, with dog sledges carrying kayaks. They could not hope to reach the drifting *Fram* again, but trusted to reaching Spitsbergen and there finding a tourist steamer. The intrepid explorer met with the success his plan deserved. Nansen and Johansen reached 86° 5′ N., the nearest to the pole that had ever then been attained. They travelled south with much difficulty, encountering many dangers, including attacks by wild beasts. They wintered on Jackson Island in a stone hut which they built and roofed with their silk tent. They lived like the Eskimo on bear and walrus meat, cooked over a blubber lamp. Travelling

south in 1896, they met F. G. Jackson, in whose relief ship they returned to Norway, arriving at Vardö on Aug. 13, 1896, full of anxiety as to the fate of the *Fram*. On that very day the *Fram* broke out of the ice, the whole party meeting in Tromsö the following week. On this unique and daring journey no life was lost, the ship was undamaged, and a rich harvest of scientific data was secured.

Sept. 22, 1631.—Foxe Channel

Luke Foxe reached his highest latitude, 66° 47′, after following the coast of Foxe Land and passing through Foxe Channel. He had left England in May 1631 in search of the north-west passage, feeling confident that he would return with a cargo of pepper from the East Indies. He did not succeed in this, but he rendered great service to geography by completing a rough survey of Hudson Bay, and by discovering and penetrating far into Foxe Channel. He also drew a map, now famous, showing with considerable accuracy the arctic regions as then known.

Societies and Academies

LONDON

Institute of Metals (Annual Autumn Meeting), Sept. 12–13.—**H. J. Gough**: Corrosion fatigue of metals (Autumn Lecture). Corrosion fatigue of metals is defined as the behaviour of metals subjected to cyclical stresses while exposed to an environment of an oxidising nature. Following a brief historical account, the nature of the general problem, the nomenclature employed, and the characteristics of laboratory tests are stated; representative failures in service are described. Consideration is then given to the general influences of chemical composition, heat treatment, and cold working on the resistance of metals to corrosion fatigue, also of the effect of time, number of cycles, and corrosivity of environment as factors in the process. Primary importance is attached to the behaviour of protective films under the straining actions associated with cyclical stressing. —**W. R. Barclay, G. A. V. Russell, and H. Williamson**: Modern works plant and equipment for the hot-working of nickel and nickel alloys. This paper describes a modern plant erected in Great Britain as a result of experience in the hot-working of nickel and its alloys, and a close study of the conditions under which similar work is carried out on the Continent and in America. The main features of the plant are: (1) hydraulic forging press; (2) hot rolling mill. The heating of sheet-bar for rolling into sheets is carried out in a specially designed electric resistance furnace.—**G. L. Bailey**: Mould materials for non-ferrous strip ingot casting. Grey cast iron is the material most generally used for moulds for the casting of non-ferrous strip ingots. Cast-iron moulds are subject to two particular defects, gas evolution from the face of the mould when this is overheated during pouring ('blowing'), and transverse cracking of the working faces. Copper is considered the most satisfactory material for strip ingot moulds. Its high thermal conductivity prevents serious temperature gradients and consequent distortion.—**E. J. Daniels**: Some reactions occurring in 'hot-dipping' processes. The part played by fluxes has been investigated and a general agreement found with diverse processes. The contamination of the liquid metal is an inevitable factor in hot-dipping, soldering, etc., and methods for controlling it are indicated.—**N. P. Allen**: The effect of pressure on the liberation of gases from metals, with special reference to silver and oxygen. The liberation of oxygen from silver during solidification has been studied by means of cooling curves. The gas is evolved when the 'internal pressure' of the dissolved gas becomes greater than the hydrostatic pressure of the liquid metal, and by applying a sufficiently large pressure to the liquid metal the formation of blowholes can be prevented. The equilibrium of the silver-oxygen system is discussed and the existence of a eutectic shown.—**J. D. Grogan and T. H. Schofield**: On the removal of gases from aluminium alloys by mixtures of nitrogen and volatile chlorides. Raw cylinder nitrogen may be employed. The quantity of chloride needed is small. Metal treated in this way possesses excellent mechanical properties.—**H. A. Sloman**: Researches on beryllium. With the progressive elimination of metallic impurities, the brittle nature of the early metal was not greatly altered. This brittleness was afterwards found to be due to a beryllium/beryllium oxide eutectic surrounding the metal grains. Most of the work has been directed towards the elimination of this oxide. Of all the methods attempted and described here, sublimation *in vacuo* has been the most effective.—**R. J. M. Payne and J. L. Haughton**: Some attempts at making beryllium-magnesium alloys. A description is given of various methods which were tried for the production of beryllium-magnesium alloys, all of which were unsuccessful.—**D. Stockdale**: The constitution of the lead-tin alloys. The micrographic method, two thermal methods, and a modified electrical conductivity method have been used in the determination of the solubility of tin in lead, which is shown to be 19·5 per cent by weight, at the temperature of the eutectic. This value is considerably higher than any other previously obtained.—**M. Cook and H. J. Miller**: The effect of different elements on the annealing and grain-growth characteristics of alpha brass. An examination has been made of the effect of additions of iron, phosphorus, manganese, and aluminium separately, and of aluminium with nickel, and aluminium with silicon, on the annealing characteristics of alpha brass by determining diamond pyramid hardness values and making grain-size measurements on cold-rolled alloys annealed at various temperatures, while the tensile properties on a number of alloys representative of the various series investigated have also been studied.—**J. H. Watson**: Liquation or 'inverse segregation' in the silver-copper alloys. The first formed primaries, whether of silver or of copper, are free to move under the influence of gravity, when the alloy is maintained for sufficient time at temperatures between the liquidus and the solidus. The primaries which have segregated under the influence of gravity are repelled from their position by the application of severe local chilling to their vicinity.

(*To be continued.*)

PARIS

Academy of Sciences, Aug. 1 (vol. 195, pp. 345-404). —**J. Costantin**: High-altitude heredity acquired by the sugar cane. Historical account of the relations between the resistance of sugar canes to disease and the altitude at which they are grown, and the results of transplanting from high to lower altitudes.—**Paul Janet**: The International Congress of Electricity of 1932.—**P. Pascal and Mlle. J. Hansot**: The quantitative study of the adsorption of metallic cations by cellulose. Results with lead nitrate, thallium nitrate, and lead chloride are given graphically.—**Lucien Daniel**: A curious graft of the chestnut and pear trees. An account of a pear tree on which a chestnut has been accidentally grafted. Each bears its proper fruit and

foliage, and both are fed by a single trunk.—**E. Bataillon and Tchou Su**: The comparative study of the initial kinetic process in the impregnated egg of *Hyla* at various stages of growth.—**Vladimir Bernstein**: The directions of Julia and of Borel of integral functions of finite order.—**A. Lafay**: The prediction of the action of a rapidly changing wind. Application to the Katzmayr effect and to autorotation.—**R. de Fleury, H. Portier, and S. Benmakrouha**: Rules of transpositions with homogeneous factors of safety of equilibrium and stability at critical deformations.—**G. Rougier**: The variations of atmospheric absorption.—**J. Cayrel**: The permeability of a vacuum and the theorems of Chipart.—**Armand Bogros and Félix Esclangon**: The excitation of atomic jets by an electromagnetic discharge of high frequency. The method described promises to be of service in the study of the hyperfine structure of spectral lines.—**G. Bruhat and P. Chatelain**: The realisation of a photoelectric polarimeter.—**P. Soleillet**: The fluorescence of a jet of zinc atoms.—**F. C. Chalklin and L. P. Chalklin**: The partial absorption in the region of the soft X-rays.—**Mlle. J. Pernet**: The magnetic rotatory power of cerous chloride in aqueous solution. The thermal variation.—**P. Fourmarier**: The response of a gas-filled photoelectric cell to a sudden illumination. Study of the causes of lag in photoelectric cells: the results are given in three curves.—**Lemarchands and Jacob**: Remarks on chemical inertia. Starting with the hypothesis that the reaction temperature between a metal and chlorine should be proportional to the product of the boiling points of the metal and the chloride formed, experimental results are given for the reaction temperatures of a number of metals with chlorine. The concordance between the measurements and the calculated temperatures is satisfactory.—**Desmaroux and Mathieu**: The influence of temperature on the structure of nitrocellulose films. A discussion of the causes of the differences between the authors' results and those of J. J. Trillat. The concentration of the solutions and the temperatures at which the film is dried affect the crystalline form.—**Berthon**: Selective adsorption by silica gel in ammoniacal solutions of the heavy metals. In ammoniacal copper solutions the complex ion $(Cu(NH_3)_2)$ is adsorbed. Ammoniacal zinc sulphate solutions behave similarly.—**Georges Delbart and Edgar Lecœuvre**: Contribution to the study of low carbon cast-irons.—**Rambaud**: A particular case of allyl isomerism.—**A. Mailhe and M. Renaudie**: The formation of various organic sulphur compounds starting with ethylene hydrocarbons. The hydrocarbons (ethylene, propylene, butylene, and amylene) mixed with hydrogen sulphide were passed over silica gel at 700° C. A complex liquid mixture was obtained containing alkyl sulphides, thiophene and its homologues, and other sulphur compounds.—**Romer**: The present condition of Mt. Pelée. The eruption of 1929-1932 resembled that of 1902 but was on a smaller scale. Some of the protective topographical features have disappeared: an eruption on the south or south-east side of the new cone might be very dangerous.—**Y. Khouvine**: Study by means of X-rays of the chitin of *Aspergillus niger*, *Psalliota campestris*, and *Armillaria mellea*. Chitin of vegetable origin has not only the analytical characters of animal chitin, for example, the crayfish, but also has the same crystalline structure.—**Maurice Leriche**: The first fossils discovered, at the north of Angola, in the prolongation of the Lubilash strata, and the synchronism of the Lubilash and Lualaba deposits.—**A. and R. Sartory, J. Meyer, and E. Keller**: The determination of the quantity of magnesium contained in the essential foods and water of different communes of Alsace and Lorraine and its influence on cancer mortality.

Cape Town

Royal Society of South Africa, April 20.—**S. M. Naudé**: The spectroscopic determination of isotopes. Molecular spectra offer a much greater opportunity for the discovery of isotopes, since the mass of the constituent atoms of the molecule enters directly in the expressions for the vibrational and rotational energy of the molecule.—**B. F. J. Schonland and J. P. T. Viljoen**: A penetrating radiation from thunder-clouds (see Nature, Sept. 10, p. 399).—**M. Rindl and P. W. G. Groenwoud**: A contribution to the chemistry of *Rauwolfia Natalensis*. The bark of the so-called 'quinine tree' (Koorsboom) is credited with possessing medicinal virtues. The cold alcoholic percolate furnishes: (*a*) Cane sugar. (*b*) An amorphous yellow alkaloid which, when administered orally or subcutaneously to cats in doses of 27 mgm. per kg. body weight, causes an elevation of temperature. The alkaloid has no definite melting point, and it resisted all attempts to obtain it or one of its derivatives in crystalline form. It is obtained by fractional precipitation of the aqueous alkaloid solution with sodium carbonate. (*c*) An amorphous alkaloid extracted from the aqueous alkaline solution with ether and giving the Rauwolfine reaction with concentrated nitric acid. (*d*) An amorphous alkaloid extracted from the aqueous alkaline solution with ethyl acetate and giving a fluorescent solution. This alkaloid does not give Rauwolfine reaction. (*e*) One or more alkaloids which appear to be very soluble in water and are not removed from the aqueous alkaline solution by shaking with immiscible solvents.

Rome

Royal National Academy of the Lincei, March 20.—**T. Levi-Civita**: Theorems of unicity and of existence for the small oscillations of a vortical thread of nearly circular form.—**L. Tonelli**: A theorem of the calculus of variations.—**S. Cherubino**: A property of oblique intuitive curves.—**J. Mirguet**: Certain new direct infinitesimal notions.—**G. Lampariello**: The instability of helicoidal vortices.—**G. D. Mattioli**: The reduction of degree of the canonical systems by means of generic integrals.—**N. Moisseiev**: The law of resistance to the motion of bodies in a pulverulent medium. (3) General case of an incoherent agitation.—**G. Supino**: Deformation of strips.—**G. Conti**: Contribution to the study of the variation of latitude.—**T. Alippi**: Certain peculiarities of the annual variation of the relative humidity. In relation to the recent communication on this subject by Viola, the author quotes the following conclusions drawn from various memoirs by Eredia (1908, 1919, 1931), dealing with observations made at a number of Italian towns. In coastal towns the moisture is lower in winter and higher in summer than in the interior of the country. On the seaboard the variations in the relative humidity, although marked, are less than in the interior. At Genoa and on the western Riviera generally, moisture is scanty (sometimes below 50) in January and reaches its maximum in summer and autumn; this anomaly is attributed by Eredia to the influence of air-currents.—**Maria Lombardini**: Calculation of the circuitation in the movements of the atmosphere.—**P. Straneo**: A new unitary theory of gravitation and electricity by absolute geometrisation. The author's studies on the unitary problem of macroscopic physics lead to a solution which, owing to its maximum generality and its extreme simplicity, appears to be definitive.—**G. Devoto**: Investigations on the dielectric constant of liquids. (7) Dielectric constant and electric moment in aqueous solution. With the α-amino aliphatic acids, distinct proportionality exists between the dielectric constant and the electric moment; this is

confirmed by the results recently obtained for glycylglycine.—C. Jucci and C. Manunta: The colouring matter of the silkworm cocoons of the Japanese green race. This pigment, for which the name bombiclorin is proposed, dissolves very readily in water and only sparingly in alcohol, and forms yellow salts with alkalis.—M. Anelli: Folding of Pleiocene soils in the Reggian Appennines.—R. Pampanini: Plants collected in Libya by the Desio mission (1931).

Forthcoming Events

Societies

THURSDAY, SEPT. 22

OPTICAL SOCIETY.—Special General Meeting at the Imperial College of Science and Technology, at 5.30 P.M.

Congresses

SEPT. 19–24

BRITISH MYCOLOGICAL SOCIETY.—Annual General Meeting at the Haslemere Educational Museum, Surrey.

Wednesday, Sept. 21.—Miss G. Lister: "Field Notes on Mycetozoa" (Presidential Address).

SEPT. 21–23

FARADAY SOCIETY.—Second Colloid Meeting at Manchester. Discussion on the "Colloidal Aspects of Textile Materials and Related Topics".

SEPT. 23–26

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.—Ninth Annual Conference at Somerville College, Oxford.

Friday, Sept. 23.—Sir Charles Sherrington (Presidential Address).

Prof. J. L. Myers: "The Relationship between Science and the Humanities".

Saturday, Sept. 24.—Dr. S. C. Bradford and Prof. A. F. C. Pollard: "Classified Subject Indexes to Periodical Volumes".

Prof. M. Greenwood: "History and Sources of Official Vital Statistics".

Official Publications Received

BRITISH

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 1, No. 9: Notes on Lower Old Red Sandstone Plants from Callander, Perthshire. By S. M. K. Henderson. Pp. 277-285+1 plate. 1*s.* 6*d.* Vol. 57, Part 1, No. 10: On the Structure and Function of the Alimentary Canal of the Limpet. By Alastair Graham. Pp. 287-308. 2*s.* 9*d.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1450: Reports and Memoranda published between 1st January 1931 and 1st April 1932. Pp. 8. (London: H.M. Stationery Office.) 6*d.* net.

Records of the Geological Survey of India. Vol. 65, Part 4. Pp. 445-541+iv+plates 19-29. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s.*

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 27: Zebu (Brahman) Cross Cattle and their Possibilities in North Australia. By R. B. Kelley. Pp. 64. Pamphlet No. 28: The Pig Industry; Report on Conditions in Great Britain and America, with Suggestions Applicable to Australia. By R. B. Kelley. Pp. 44. (Melbourne: H. J. Green.)

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series, Vol. 20, Memoir No. 2: *Homoxylon rajmahalense*, Gen. et sp. nov., a Fossil Angiospermous Wood, devoid of Vessels, from the Rajmahal Hills, Behar. By Prof. B. Sahni. Pp. iv+19+2 plates. (Calcutta: Government of India Central Publication Branch.) 1.12 rupees; 2*s.*

The Geology of the Baria State (Revakantha Agency). By R. Rama Rao. Pp. x+152+20 plates. (Devgad Baria: Secretariat Office.) 5 rupees.

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1931. Pp. x+298+9 plates. (London: H.M. Stationery Office.) 5*s.* net.

Report of the Advisory Council of the Science Museum for the Year 1931. Pp. 40. (London: H.M. Stationery Office.) 9*d.* net.

Proceedings of the Royal Society. Series A, Vol. 137, No. A832, August 2. Pp. 243-480. (London: Harrison and Sons, Ltd.) 12*s.*

Empire Fibres for Marine Cordage: Sisal Hemp and New Zealand Hemp. Rope Tests (Fourth Series): Report of Investigations conducted by the Imperial Institute. Pp. 8. (London: Imperial Institute.) 6*d.*

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FOREIGN

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CATALOGUES

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SATURDAY, SEPTEMBER 24, 1932

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Chemical Societies and Co-operation

THE industrial complexion of the present-day world, with its political and financial complications, has of necessity led numerous institutions concerned with the production and distribution of commodities, and with means to assess and exchange their value, to abandon convenient and traditional procedure and to discover alternatives which have the merit, under the new conditions, of combining self-preservation with the supply of the public needs. The science of chemistry has been harnessed to the industrial machine with a rapidity which appeared unlikely twenty years ago, and its record of service is already such as to presage the extension, as quickly as the difficulties of the moment permit, of this collaboration.

Responsibility for promoting such co-operation is shared by the Government and other public bodies, by industrialists, and by the chemical profession itself; but whilst the acquisition of chemical knowledge is a task shared directly or indirectly by all of these, its distribution is a burden which is borne almost entirely by the producers themselves. Hence many institutions devoted to the extension of scientific knowledge are faced with the same problems as the interests to the assistance of which they have been summoned. They have now to consider afresh how they can best realise their increasing responsibilities towards the national needs, while at the same time finding means to guard against serious deterioration of their distributing organisation.

Chemical societies, in common with other scientific bodies, are not greatly—if at all—concerned with questions of professional rewards, for the care of which provision is made by appropriate professional organisations. They acknowledge that it is one of their duties to promote scientific intercourse among their members, and to make such provision as may be deemed necessary to facilitate research and its discussion; but the principal duty which is laid upon them by common consent as well as by the force of circumstances is to publish to the world the records of original investigation, to do so as far as is possible without any restriction other than the scientific value of the material, and to prepare and distribute summaries of current researches in a world-wide or limited field.

This twofold publication is the very foundation of all new knowledge, and the disastrous effect of any appreciable curtailment—apart from such devices for abbreviation as may be easily intelligible to workers in the science—is only too fully realised. Consequently, much serious consideration has of

late been given to the possibility of reorganisation, co-operation, federation, and unification of the various societies devoted primarily or exclusively to promoting advance in chemical knowledge. It is, for example, scarcely fortuitous that Prof. G. T. Morgan dealt at some length with the subject in his presidential address to the Society of Chemical Industry in July, and that Prof. G. G. Henderson's presidential address to the Chemical Society in March also referred to the matter: neither were Prof. J. F. Thorpe's observations in his presidential addresses to the Chemical Society in 1930 and 1931 intended for the consideration only of fellows of that Society. Indeed, although these two chemical societies have properly taken the lead in the examination of the position and in the suggestion of methods whereby present difficulties may be surmounted and future progress assured, the problem is one which vitally concerns every chemical association and every research laboratory in the British Commonwealth.

Naturally enough, delicate and complex considerations arise with every suggestion of reunion or federation—two methods whereby considerable economy in administrative costs without contraction in scientific services might be anticipated—but encouragement is to be found in the manner in which these difficulties are being examined and discussed. Moreover, confidence arises from the fact that, for the past eight years, a substantial measure of joint operation has been successfully achieved in connexion with the publication of abstracts of chemical literature. It is well known that, by the establishment in 1924 of the Bureau of Chemical Abstracts, a body composed of representatives of the Chemical Society and the Society of Chemical Industry and charged with the production of a comprehensive and world-wide survey of current researches in both pure and applied chemistry, substantial economies have been rendered possible, while at the same time the ever expanding literature of the science is summarised and indexed with commendable accuracy, promptitude, and completeness. There can be few among those conversant with the work of this undertaking, with the needs of research workers both in academic and in industrial laboratories, and with the moderate financial resources at the command of the two societies, who would not declare this experiment in co-operative enterprise to be an unqualified success; indeed, we are unaware of any suggestion having been made that the older procedure, with its inherent lack of co-ordination and inevitable duplication, should be resumed. Few, too, would contest the desirability, in general, of a wider measure of co-operation in which other societies would participate, in order that efficiency might go hand in hand with elasticity and stability, and that the financial clouds which obscure clear vision of the future and cause anxiety for the continued supremacy of British Chemical Abstracts might be dissipated once and for all.

In his address Prof. Morgan quoted some pertinent facts and equally instructive figures; even if we admit that the exact significance of both depends on the point of view, we are still constrained to point out the inequity of so severe a task—albeit but part of the whole duty of publication—being left on the shoulders of two out of perhaps sixteen societies which are devoted to the furtherance of chemistry in one or other of its branches. Earlier this year Prof. Henderson referred to this circumstance with commendable frankness. "On these two societies alone", he said, "falls the financial burden of this great work, work which is for the benefit of every chemist in the country. It is singular and anomalous that hundreds, perhaps even thousands, of professional chemists exist here, who make no contribution to this burden, who do nothing to help the cause of chemistry in the way that is most urgent, most necessary, and most expensive." Likewise Prof. Thorpe in 1931 said: "The burden of publication now falls almost exclusively on the Chemical Society and the Society of Chemical Industry, and although it is probably correct to assume that the Journals of these Societies are of interest chiefly to their members, such an assumption cannot be made in the case of the Abstracts, which ought to be of interest to all chemists, and ought to be supported by all chemists." Indeed, we would go even further and submit that the fundamental importance of chemistry to our national prosperity lays upon the State itself the duty of rendering timely assistance in this matter.

We come, therefore, to the following conclusions: First, that the present financial circumstances of the chemical societies of Great Britain demand either curtailment of services to chemists of all descriptions, or some countervailing form of retrenchment. Second, that the reduction in administrative expenses which in the course of time would follow unification or some form of very close association would assist in removing these financial difficulties, and would at the same time promote solidarity and efficiency. Third, that a substantial experiment in joint publication has proved successful over a considerable period. Fourth, that the cost of, and responsibility for, certain

essential activities ought to be shared more widely. Taken together, they present an almost unanswerable case for amalgamation or federation, although of course they do not indicate exactly how it is to be achieved. As Prof. Morgan has pointed out, advocates of reunion have to face the fact that certain kindred societies have a mixed membership, consisting only partly of chemists; yet this has not deterred the Faraday Society and the Chemical Society from entering into conversations with the view of undertaking joint publication representative of physical chemistry in Great Britain. It has also been suggested that the news section of *Chemistry and Industry* should be published by a combination of the main chemical associations, and should be " an outward and visible sign of the reunion to which many of us aspire ". " Is it not high time ", asked Prof. Morgan, " that we evolved a considerable chemical organisation with a comprehensive chemical journal worthy of that community of nations known as the British Empire ? "

Many of us, while not pretending that geographical boundaries can circumscribe the sciences, feel strongly that the national consciousness of British scientific achievement might with advantage be stimulated in this way and by other like means. " Chemistry House ", which would have commanded public interest, was conceived as a means whereby the various societies representing chemistry and allied subjects might be brought into close physical association, so that certain activities, such as the library and a bureau of information, might be conducted jointly. Unfortunately, the project was born into a world of financial, political, and economic unrest, which soon became a panic, and the scheme must now submit to rebirth in less troublous times. Here again is a plan which carries with it the certainty of eventual economic advantage combined with that increase in effective service which cannot fail to accompany centralisation and the multiplication of opportunities for co-operation, if indeed it does not lead to the actual regrouping of chemical societies in larger units.

It ought not to be impossible by other methods, however, to secure a substantial part of the economies adumbrated by the " Chemistry House " scheme, and to do so relatively cheaply and without pressing the thorny questions of amalgamation or autonomy to an immediate decision. With this aim Sir William Pope, in a communication to *Chemistry and Industry*, recently proposed that Mr. E. R. Bolton, Dr. L. H. Lampitt, Prof. G. T. Morgan, Prof. J. C. Philip, Mr. J. Davidson Pratt, Dr. F. L. Pyman, and Mr. W. Rintoul, as representing the principal societies concerned, should be asked to constitute a committee which would consider how the resources of the various bodies concerned with the professional and scientific welfare of chemists can be most economically and efficiently utilised. If, for example, administration could be concentrated under one head in one building, the Chemical Society's library and rooms at Burlington House continuing to be the chief centre of scientific and technical activity, substantial mutual advantage would doubtless result.

But why, it may be asked, should these considerations of unity or separation, of co-ordination or non-co-operation, of economy or stringency, be regarded as matters of interest to citizens outside the ranks of the chemical profession ? Why, we might reply, were the conversations at Ottawa of interest to others besides professional politicians and economic theorists ? At least they have this in common : that the science of chemistry and the science of government, each depending for its operation and extension on a highly trained 'civil service ' and on adequate and accurate information, are both deeply concerned with the resources of the British Empire and with the use that we and our fellow-subjects overseas can make of them. " The time is ripe ", Prof. Morgan said, " for a systematic study of the material resources of the British Empire, and this task is mainly a chemist's job. Many of the natural products of the Dominions and Dependencies are in need of intensive chemical investigation. To carry out such researches in a thoroughly effective and comprehensive manner needs the expert organisation which could be best supplied by a central body fully representative of British chemistry. Every branch of chemical science would have an essential part to play in this great undertaking."

Benjamin Franklin

The Ingenious Dr. Franklin : Selected Scientific Letters of Benjamin Franklin. Edited by Nathan G. Goodman. Pp. xi + 244. (Philadelphia : University of Pennsylvania Press ; London : Oxford University Press, 1931.) 15*s*. net.

CENTENARIES are fashionable nowadays, and certainly the bicentenary of the Philadelphia Library is a day to be marked with a white stone. Franklin's restless and versatile mind was ever occupied with schemes for human betterment, and one of the most beneficial of his many beneficent deeds is perpetuated in the inscription telling us that " . . . the Philadelphia Youth [then chiefly

artificers] . . . in MDCCXXXI . . . cheerfully, at the instance of Benjamin Franklin, one of their number, instituted the Philadelphia library ".

Franklin's activities and personality are buried in some ten volumes of his collected works. One-volume editions of his life and works have seen the light—the reviewer possesses one published at Bungay in Suffolk in the early years of the nineteenth century, but he is unacquainted with any modern critical selection, and the choice of the year 1931 to give to the twentieth-century reader some notion of the many-sidedness of Franklin's genius was a very happy one.

To the reviewer's mind, the execution of the idea is somewhat imperfect—to confine the volume to a selection from the scientific letters alone is to give a very lop-sided picture of the career and character of Franklin. And an amazing picture it is, even for a society so homely that we find the Governor of Pennsylvania hobnobbing in a tavern over a bottle of madeira with an obscure printer's apprentice, even for an America of such incredibly minute dimensions that Franklin's brother was accounted over-daring in initiating the *New England Courant*, the *three* already existing newspapers being regarded as more than sufficient for the needs of the continent. That picture is not brought out by a perusal of the letters alone, and our ideal Franklin memorial volume must certainly contain, to begin with, the autobiography, complete and unabridged.

The study of a personality is always fascinating, and Franklin's autobiography opens to us a masterful, sententious, frugal, and inquiring mind, a mind which, none the less, appreciates and sympathises with human weaknesses and is not afraid to chronicle its own lapses. Truth to tell, some of Franklin's endeavours to cultivate the morals, major and minor, are apt in these days to raise a smile. He would indeed be an exceptional youth who should to-day draw up a schedule of thirteen virtues wherein to test himself, concentrating each week on one particular merit, and endeavouring to keep the daily squares allotted to it free from the black marks which indicate a lapse. Yet Franklin conscientiously carried out such a programme, completing it in thirteen weeks, and repeating it four times in a year. The schedule reproduced shows the results of a week's analysis, during which he had elected to concentrate on temperance.

A carping critic may find something of smugness in such a record, which is not apparent to those who know the autobiography in detail; it is not all a tale of achievement, and some of us can sympathise, ruefully enough, with Franklin's efforts to cultivate order and method, and his resolve at times to be content with a second-best.

TEMPERANCE

"Eat not to dullness; drink not to elevation."

	Sun.	M.	T.	W.	Th.	F.	S.
Tem.							
Sil.	×	×		×		×	
Ord.	×	×			×	×	×
Res.		×				×	
Fru.		×				×	
Ind.			×				
Sinc.							
Jus.							
Mod.							
Clea.							
Tran.							
Chas.							
Hum.							

"Like the man", as he himself says, "who, in buying an axe of a smith, my neighbour, desired to have the whole of its surface as bright as the edge. The smith consented to grind it bright for him, if he would turn the wheel; he turned, while the smith pressed the broad face of the axe hard and heavily upon the stone; which made the turning of it very fatiguing. The man came every now and then from the wheel to see how the work went on; and at length would take the axe as it was, without further grinding. 'No,' said the smith, 'turn on, turn on, we shall have it bright by and by; as yet it is only speckled.' 'Yes,' said the man, 'but *I think I like a speckled axe best*.'"

There are many of us who, in higher virtues than that of order, find that we like a speckled axe best.

The reader of the autobiography will find it not without interest to turn over the pages of the confessions of Rousseau, who was writing at about the same period as Franklin. The outpourings of such an introspective Heautontimorumenos as Jean Jacques differ *toto cœlo* from the calm record of Franklin. The extraordinary incident of the kettle, the story of the stolen riband, and the adventure of Madame de Warens are part and parcel of the fascinating, if sometimes repellent, character of Rousseau; Franklin's lapses from the major virtues, faithfully chronicled as they are, are but passing incidents in a life devoted whole-heartedly to the advancement of knowledge and to the practical betterment of mankind.

His long life, stretching from 1706 until 1790, saw many changes; none more striking than the metamorphosis of the printer's apprentice of 1718 to the Minister-Plenipotentiary to France of 1778, and the President of Pennsylvania of 1785. Any adequate volume dealing with Franklin must trace

this change, and it can nowhere be better followed than in the autobiography which takes us to 1757, and in a discreet abridgment of Jared Sparks' continuation of the autobiography.

The selections in the admirably printed and produced volume before us illustrate sufficiently well the varied nature of Franklin's scientific work, and the practical character of his genius. We see him designing lightning rods and bifocal lenses; discussing the best form of stove fireplace; observing the effect of oil in stilling waves—an experiment Franklin first performed on a pond on Clapham Common—and carrying, "whenever I went into the country, a little oil in the upper hollow joint of my bamboo cane, with which I might repeat the experiment as opportunity should offer"; mounting musical glasses, suitably tuned by filing, on a common horizontal spindle which could be worked by a treadle, and thus devising the instrument called the armonica; sending up his kite of cedar-wood and silk fabric, with a key at the lower end of the string, into a thunder-cloud, and—hardy fellow—telling his correspondent that "when the rain has wet the kite and twine, so that it can conduct the electric fire freely, you will find it stream out plentifully from the key on the approach of your knuckle"; giving lessons in the art of swimming, in the art of procuring pleasant dreams, and, generations before the advent of *Nacktkultur*, rising early and sitting in his chamber "without any clothes whatever, half an hour or an hour, according to the season, reading and writing".

Eripuit caelo fulmen, sceptrumque tyrannis. There is much in this volume concerning the wresting of the lightning from heaven (though there is a strange omission of the important letter to Peter Collinson of September 1753), much which illustrates Franklin's minor scientific activities. But we miss the familiar dialogue between Franklin and the Gout; we miss the sententious aphorisms of Poor Richard, and the story of the whistle; we miss those letters which reveal Franklin as a statesman and, in particular, the details of his examination before the House of Commons in 1766 relative to the repeal of the American Stamp Act.

It is, of course, entirely within the province of an editor to delimit the area of his selections, and the present volume is definitely a selection of scientific letters, which provides most interesting and varied fare for the reader. Nevertheless, one cannot but feel that an opportunity has been missed, and that the ideal one-volume edition on Franklin still remains to be published.

ALLAN FERGUSON.

The Value of Scientific Knowledge

(1) *Reason and Nature: an Essay on the Meaning of Scientific Method.* By Morris R. Cohen. Pp. xxiv + 470. (London: Kegan Paul and Co., Ltd., 1931.) 21*s.* net.

(2) *Science and First Principles.* By Prof. F. S. C. Northrop. Pp. xiv + 299. (Cambridge: At the University Press, 1931.) 12*s.* 6*d.* net.

(3) *The Logic of Science.* By Prof. Harold R. Smart. Pp. viii + 237. (New York and London: D. Appleton and Co., 1931.) 8*s.* 6*d.* net.

(1) MODERN thought undoubtedly suffers from the actual hostility between Nature and reason, which were once joined in the Hellenic ideal of science. The appeal for an effective and conscious union of these two fundamental elements of science is inspiringly illustrated in Prof. Cohen's work, which thus carries under its learned guise a constructive message to philosophers and men of science. Prof. Cohen believes neither in a conventional supernaturalism nor in a sentimental irrationalism, but he finds much inspiration in the older thinkers, and he is thus led to make this modest but useful, if not heroic, pronouncement: "The philosopher, whose primary interest is to attain as much truth as possible, must put aside as a snare the effort of originality. Indeed, it seems to me that the modern penchant for novelty in philosophy is symptomatic of restlessness or low intellectual vitality." It is in this spirit of a true friend of wisdom that he surveys the general meaning of the principles of procedure according to which scientific results are obtained and according to which these results are being constantly revised.

In the first part of the book, Prof. Cohen deals with the mental attitudes, such as historicism, psychologism, authority, pure experience, intuition, and creative imagination, which seem to guide the modern research worker. The two remaining parts are devoted to an analysis of natural science, including biology and psychology, and of social science, with special reference to the postulates of reason.

Taking at random one example of Prof. Cohen's inquiry—that which deals with the nature of mathematics—we find him discussing the logical character of pure mathematics, their relation with intuition, and the important question of how applied mathematics is possible. His general conclusion is that the relational structure of mathematics, which is their very object, is just as objective as the physical entities related; and that the laws of mathematics are applicable, because they are the

laws according to which all objects or realities can be combined. The assumption that numbers and mathematical or logical laws are mental is due, according to Prof. Cohen, to the "vulgar prejudice" that only particular sensible entities exist in Nature, and that relations, abstractions, or universals cannot have any such objective existence. "But this is a shabby subterfuge: for these numbers or relations are also numbers and relations of things; and any assertion with regard to these abstractions is either true or not. Now truth, whatever it is, is not a quality which inheres in a proposition simply because it is mental, but a proposition is true because of factors other than the fact that I now think this proposition" (p. 203). It follows that logic and pure mathematics apply to Nature because they describe the invariant relations which are found in it; and thus they enable us to extend our knowledge of Nature by supplying us with illuminating perspectives and by insisting on relevance which is a condition of sanity.

(2) A similar attitude, but perhaps with a more pragmatic inclination, seems to be adopted by Prof. Northrop in discussing the claims of modern theoretical science. He also thinks that the complexity, richness, and beauty of the scientific, æsthetic, and religious experience find their source in the happy combination of these three fundamental principles: the primacy of motion, the source of rationality and necessary order in the physical referent for motion, and the identification of the purely psychical with bare indeterminate experienced quality. This view leads Prof. Northrop to describe reality, as known by scientific philosophy, as æsthetic immediacy with its physical, formal, and psychical conditions made specific. As an example of his conception of the standard thinker, he gives us Leonardo da Vinci, for whom "the physical and the formal were grasped without being torn from the vivid psychical immediacy in which both are embedded".

The importance of these general ideas is illustrated by some very interesting considerations on certain specific scientific theories, such as the theory of relativity, the quantum and wave mechanics, and the fundamental principles of biology and anthropology. For example, in discussing the various aspects of the theory of relativity, Prof. Northrop suggests that the conclusions reached in connexion with the necessary consequences of the theory, if properly treated, should possess equal certainty, since they merely designate what else must be true if the theory is true. But he holds that the theories of the finite universe of Einstein and de Sitter, and the unitary field theories of Weyl, Eddington, and Einstein, rest on more questionable assumptions, and lack the experimental verifications which Einstein's earlier discoveries enjoy. Thus Prof. Northrop is led to think that the physical theory of Nature in a kinetic atomic form must be true; for after introducing and recognising more relativity than even the most imaginative speculative mind has ever conceived, Einstein's discoveries reveal that there is something absolute in Nature, remaining objective and invariant through all the relativity which exists, and that this absolute factor is matter and motion.

(3) The necessity of hanging the bulk of our scientific knowledge to something real, something absolute beyond the fact of perception, is also prominent in the analysis of the sciences proposed by Prof. Smart. His object is to answer some pertinent questions which arise necessarily in one's mind when one contemplates the lofty achievements of modern science. Is mathematical knowledge the product of pure thought functioning apart from all experience? Should we say that physics is a branch of geometry? Or does it tell us only of a certain orderliness amongst our purely subjective perceptions? Are substance and causality outworn conceptions, no longer applicable to natural phenomena? What possible solution can be proposed to the interminable struggle between mechanists, teleologists, and vitalists in biology?

These and other queries show the range of Prof. Smart's considerations. Generally speaking, he is of opinion that a *via media* suggests the best solutions to these fundamental problems with regard to biology; for example, he believes that in the biological sciences, the conception of natural kinds dominates the search for laws, somewhat as physical conceptions condition the application of mathematical principles to physical phenomena. As for mathematics, Prof. Smart suggests that the mathematician shares with other natural scientists the content supplied by the world of existential phenomena. The hypothesis of pure mathematics being a completely *a priori* science, functioning apart from all experience, is denounced as the enemy of all science and philosophy, because it lands us into all sorts of impossible dualisms and irresolvable contradictions.

Reaching by degrees the universal plane of philosophy, Prof. Smart contends that scientific knowledge constitutes itself a revelation not only of Nature, but also of mind itself, which presupposes, however, the independent existence of Nature. Consequently, a law of Nature ultimately implies both an objective order of which it is a representa-

tion, and a principle of intelligibility of which it is an expression. It follows that the task of philosophy involves the differentiation and integration of these several values in a systematic unity.

There is no doubt that the considerations put forward by these three writers will make a wide appeal to those whose experience in the field of speculation has led them to believe that present-day science seems to be struggling along against a sense of unreality. Extreme views in the interpretation of our scientific knowledge can be useful during a certain time, for they suggest new problems, novel solutions, and original methods of approach. But they can scarcely hold the field permanently; and the time now seems to have come when some kind of reasonable unification is desirable. This unification is the more important as the general crisis in which our society appears to be involved can scarcely find a satisfactory solution if leaders of thought are not certain amongst themselves as to the real value of their knowledge.

THOMAS GREENWOOD.

Furs and Feathers

Die Rohstoffe des Tierreichs. Herausgegeben von Ferdinand Pax und Walther Arndt. Lief. 6. Pp. 449-576. 12 gold marks. Lief. 7. Pp. 577-736. 16·20 gold marks. Lief. 8. Pp. 737-880. 14 gold marks. (Berlin: Gebrüder Borntraeger, 1931.)

IN the sixth part of this work the account of the fur-bearing animals is completed. It is satisfactory to note that the colony of seals on the Pribilof Islands is increasing and comprises about a million individuals. In 1929 about forty thousand skins of this seal were collected. The order Carnivora is stated to include the largest number of species of fur-bearers and to provide the most costly skins—for example, those of the American fox, the finest examples of which from the Hudson Bay region, Labrador, and Alaska, are worth 50-400 marks each, and about 250,000 a year are sold. Of the European fox, about a million skins a year are collected; the Norwegian examples command the highest price, about 100-150 marks. The dearest fox skin is that of the silver fox, the finest specimens of which come from Labrador and have been known to realise up to 6000-8000 marks a skin.

The account of the Karakul sheep, the skin of which is known in commerce as 'Persian', includes reference to the lamb-skins of this species. The small skins, often spoken of as those of unborn lambs, are the skins of lambs the mothers of which died at or shortly after their birth. The statements that the ewes are roughly treated to cause premature birth of the lambs is definitely said to be untrue, and is unlikely, as the ewes are worth 100-150 marks and the skins of very young lambs about twenty marks each.

The number of species of animals the skins of which form an article of commerce as furs is given as about 175. Statistics of the number of pelts sold in 1928 are given for the principal countries, and show that about a hundred million rabbit skins were marketed in Europe and a similar number in Australia; in fact, that about sixty per cent of the skins coming on the market were those of the rabbit, which reached a total of 209 millions. The next in order of number were the hare, 32 millions; sheep, 30 millions; mole, 21 millions; squirrel and musk-rat, 17 millions each. The total value of the world production of rough skins in 1928 was about £77,000,000.

A chapter of twenty-four pages gives a useful summary of present knowledge and practice in the raising of fur-bearing animals, which has in recent years assumed considerable importance. The number of such farms at the end of 1929 in Germany was about five hundred, and there is corresponding development in many other countries. The principal animals reared are the silver fox, blue fox, mink, raccoon, skunk, and musk-rat—the last especially in Canada. Details of the layout and working of some of the farms are given. The spread of the musk-rat in Germany is graphically illustrated by a map which shows the rapid extension of its range between 1907 and 1924. This species has become a serious nuisance in Germany and has caused damage in central Scotland.

The seventh part and nearly the whole of the eighth part of this work are devoted to an account of the skins and feathers of birds, the orders of birds being considered in systematic sequence. The methods of treating skins and feathers to improve their appearance and to destroy the parasitic insects and mites are described, and the extent and value of the ornamental feathers and skins imported into Germany, England, and other countries are shown in statistical tables. A separate section is devoted to the skins and feathers of ostriches (there is only a relatively small trade in those of the South American rhea and a quite inconsiderable trade in those of the Australian emu and cassowary) and to ostrich farming. The difference between the number of ostriches in the Union of South Africa at the end of 1913 (776,313) and in 1926 (104,578) bears striking testimony to the influence of fashion. The

essentials of a good ostrich feather and the defects —for example, 'barring'—are noted, and statistics are added of the number and value of the feathers produced.

In the section on feathers for beds—obtained chiefly from ducks, geese, and hens, in many cases as a by-product—and on down, many details are given of their physical properties and of their preparation for their principal uses. The various uses of feather-quills and the employment of feathers and bird-skins for ornament by native peoples are described. This section concludes with a very useful summary of the species of birds the skins and feathers of which are of commercial value, with a note of their geographical distribution.

Bibliographies are appended to the principal sections, and interesting illustrations, chiefly from photographs, are placed in the text. This work presents, in concise and well-arranged form, up-to-date information, both scientific and commercial, on the skins of mammals and birds, and can be recommended as an authoritative source of reference.

Short Reviews

Die natürlichen Pflanzenfamilien: nebst ihren Gattungen und wichtigeren Arten, insbesondere den Nutzpflanzen. Begründet von A. Engler und K. Prantl. Zweite stark vermehrte und verbesserte Auflage, herausgegeben von A. Engler. Fortgesetzt von H. Harms. Band 19*a*: *Angiospermæ, Reihe Pandales.—Reihe Geraniales, Unterreihe Geraniineæ (erster Teil).* Redigiert von F. Pax. Pp. iv + 470. 60 gold marks. Band 19*c*: *Angiospermæ, Reihe Geraniales, Unterreihen Dichapetalineæ, Tricoccæ, Callitrichineæ.* Redigiert von F. Pax. Pp. iv + 251. 32 gold marks. (Leipzig: Wilhelm Engelmann, 1931.)

THE publication of the new edition of "Die natürlichen Pflanzenfamilien", which has been supervised, since the death of Engler, by Dr. H. Harms of Berlin, is progressing steadily, two volumes, namely, 19*a* and 19*c*, having appeared during 1931. Vol. 19*a* begins with the monotypic order Pandales, based on *Panda oleosa* Pierre, a West African forest tree of uncertain affinity. This is followed by ten families of Geraniales, from Oxalidaceæ to Burseraceæ respectively. More than a third of the volume is occupied by the account of the Rutaceæ, which, together with those of Zygophyllaceæ, Cneoraceæ, Simarubaceæ, and Burseraceæ, was prepared by the late Prof. Engler. The great extent of recent research on the Rutaceæ is reflected in the number of genera now recognised in that family, 145 as compared with 111 in the first edition. This is due partly to extensive generic segregation in the subfamily Aurantioideæ by Swingle and others. Both text and figures are much blacker than in the first edition, the figures in some cases—for example, *Casimiroa edulis* (p. 305)—being far too heavily shaded. Most of them, however, are very clear.

Vol. 19*c* is mainly taken up by the account of the Euphorbiaceæ, by Pax and K. Hoffmann. This great family now includes 283 genera, as compared with 209 in 1890, and the introductory matter has been thoroughly revised, now extending to 31 pages instead of 13. The necessity for a second edition is therefore obvious. In this volume also many of the illustrations—for example, *Mallotus philippinensis*—are, unfortunately, far too black.

Under the general direction of Dr. Harms, the high standard of the first edition is, on the whole, maintained.

Hume's Philosophy of Human Nature. By Prof. John Laird. Pp. x + 312. (London: Methuen and Co., Ltd., 1932.) 12*s*. 6*d*. net.

HUME becomes more and more popular among philosophers. The reason is that we find ourselves in a period very similar to his. Indeed, it is felt that the dogmatic interpretations which have been given of the momentous discoveries of our time are not quite satisfactory in themselves. Before proceeding to the formulation of new theories, it appears necessary to clear the ground, which implies primarily the action of a sceptic mind. It is quite natural, then, that philosophers should turn for inspiration and encouragement to David Hume, the father of modern scepticism.

Though Hume was versed neither in mathematics nor in natural science, the critical examination he made of their theoretical presuppositions is a permanent addition to our philosophical knowledge. His great contribution to the discussion is his distinction between 'knowledge' and 'probability', which is at the basis of inductive inference.

Prof. Laird explains and examines Hume's principles of causal inference in Chap. iv., perhaps the most important of his book. There we find a remarkable discussion of questions such as the uniformity of Nature, belief, testimony, conjectural probability, analogy, and experimental method, where Hume anticipates many considerations which we find later in Stuart Mill's "System of Logic". One of Hume's most peculiar principles is that which denies plurality of causes and plurality of effects, though it may be doubted whether he was entitled to hold it without any decisive arguments. In his chapter about "Space, Time, and External Existence", Prof. Laird discusses also many interesting doctrines of Hume's bearing on the foundations of mathematics. His long acquaintance with Hume's system has made Prof. Laird one of the safest guides to the complexities of his philosophy; and the book he has produced is a permanent addition to the philosophical literature of the day.

Volumetric Analysis. By G. Fowles. Pp. xii + 202. (London: G. Bell and Sons, Ltd., 1932.) 6*s*.

THIS book will be welcomed by teachers of chemistry who are desirous of placing in the hands of their students a lucid exposition of up-to-date methods of volumetric analysis. Although intended for uni-

versity students and candidates for university scholarships and the National Certificate in Chemistry, the book contains much matter which will be of interest to many chemists.

Mr. Fowles has been at considerable pains to expound the principles upon which volumetric analysis is based, so that in carrying out the determinations the student will be consciously applying these principles and not merely performing a set of experiments without regard to the physico-chemical theories involved.

The first two chapters are devoted to general principles, and include much information on equivalents, indicators, calibration, and the selection of substances as standards. The next four chapters deal with the various methods of volumetric determinations—neutralisation, in which the theory of indicators is discussed; oxidation by permanganate, dichromate, bromate, and iodate; reduction by titanous sulphate; iodometry; and precipitation. The final chapter takes the form of a synopsis, and contains the volumetric processes for the estimation of all common metals, acid radicals, and many organic compounds.

Embodying, as this book does, the recent advances in volumetric analysis, it is a very useful addition to chemical literature.

Why we Oppose the Occult. By Prof. Émile Cailliet. Translated by Prof. G. F. Cole. Pp. v + 200. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1931.) 8*s*. 6*d*. net.

To the modern mind the very word 'magic' stands for an idea which is little short of degrading. Yet we have to remember that, according to high authorities, magic was the real foundation of religion, the most divine creeds having belief in magic as their basis. Furthermore, the ancient Oriental magicians passed on their accumulated observations to the Greeks, enabling the latter to lay the foundations of mathematics, so that magic may be said to be the origin of science—of science through the intermediary of religion, as Frazer shows. But societies which thus owe so much to magic not only free themselves from it, but also vigorously reject it, turning from the occult with disgust. In our own day the occult is the object, not merely of disbelief, but also of active opposition and ridicule. Why? That is the problem to which Prof. Cailliet addresses himself in this book, with many examples drawn from his intimate knowledge of beliefs and practices in Madagascar.

Physics: Fundamental Laws and Principles with Problems and Worked Solutions. By Edgar Booth and Phyllis M. Nicol. Pp. 648. (Glebe, N.S.W.: Australasian Medical Publishing Co., Ltd., 1932.) n.p.

This volume, which is of a good intermediate standard, is divided into two main sections. The first part consists of thirty-six chapters, and expounds the fundamental principles and laws of physics in a series of clear statements which are driven home by means of a large number of illustrative problems, of a mixed bookwork and rider type.

The second part consists of answers to and worked solutions of the problems given in the first part.

The whole book bears evidence of much care and thought in its preparation; it should prove a useful aid in testing and co-ordinating the knowledge of a student of elementary physics.

The Doctor Explains. By Ralph H. Major. Pp. xvi + 277 + 27 plates. (London: Chapman and Hall, Ltd., 1932.) 15*s*. net.

It would be difficult to present a more interesting and comprehensive account of progressive medical science and practice than that covered by this book. The author succeeds brilliantly in his endeavour to explain in untechnical language how the methods of treatment and diagnosis employed by modern physicians and surgeons are the results of research in many scientific fields, and his work should do much to promote intelligent interest in the preventive as well as the curative services of medicine. The book is an inspiring record of human thought and action towards the conquest of disease, and it will be read with both profit and pleasure not only by the laity but also by many general medical practitioners.

Hippokratesglossare. Von Max Wellmann. (Quellen und Studien zur Geschichte der Naturwissenschaften und der Medizin, herausgegeben vom Institut für Geschichte der Medizin und der Naturwissenschaften, redigiert von P. Diepgen und J. Ruska, Band 2.) Pp. iv + 88. (Berlin: Julius Springer, 1931.) 16 gold marks.

This learned memoir is a valuable addition to the history of the sources of the Hippocratic commentators. The main point of its author is that Erotian, who wrote a glossary on the Hippocratic works during Nero's reign, was not a grammarian, but a physician. Then he goes on to discuss the sources of Erotian, and to compare previous glossaries of the Hippocratic works with them. The glossary of Bakcheios, who published the first edition of the Hippocratic works, was superseded later by the commentaries of Glaukias, Epikles, Heraclides of Tarentum, and Euphorion the Grammarian.

Die lichtelektrische Zelle und ihre Herstellung. Von Dr. Richard Fleischer und Dr. Horst Teichmann. Mit einer Einführung von Prof. Dr. H. Dember. (*Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe*, herausgegeben von Dr. Raphael Ed. Liesegang, Band 27.) Pp. xii + 175. (Dresden und Leipzig: Theodor Steinkopff, 1932.) 12 gold marks.

This unpretentious little volume gives, in compact and handy form, a very clear conspectus of the properties and methods of production of light-sensitive cells. It is well produced and illustrated, and its usefulness is enhanced by a critical bibliography of some 230 entries, ranging over the years 1877–1931.

Physical and Observational Evidence for the Expanding Universe

By J. H. REYNOLDS

SO much has been written in recent years on the subject of the expanding universe from the theoretical point of view, that there is no need here to give more than a summary of the position, following Sir Arthur Eddington. The 'Einstein universe' was a conception based on a static solution of Einstein's field equations in which matter was distributed with uniform density, filling a closed space, and in equilibrium owing to the balancing of gravitational attraction and cosmical repulsion. In 1917, Prof. W. de Sitter, of Leyden, put forward his now famous hypothesis, predicting large velocities of recession for distant objects, which was based on a small modification of Einstein's equations. The difficulty about the 'De Sitter universe' was that it was empty, so that the cosmical repulsion acted without hindrance.

The discovery, mainly owing to V. M. Slipher, that the line shifts in the spectra of the spiral nebulæ were large and predominantly towards the longer wave-lengths, lent a considerable measure of support to de Sitter's theory, but obviously the universe was not empty of matter, and some other intermediate solution had to be sought. Such a solution was found ultimately by Abbé G. Lemaître in 1927, although its importance was overlooked until de Sitter and Eddington directed attention to it in 1930. They realised at once that a non-static solution of the Einstein equations was possible, so that an expanding or contracting universe was inevitable from Einstein's law of gravitation. The question whether contraction or expansion would best agree with the conditions actually existing was considered settled by the observed displacements of the nebular absorption lines towards the longer wave-lengths, which on the Doppler principle would be interpreted as measures of velocities of recession.

The observational evidence required to establish the hypothesis, and to evaluate the expansion factor, lay in two separate series of data: (1) an adequate number of measured spectra of the extra-galactic nebulæ with as wide a range of systems as possible, and (2) a trustworthy scale of distances for these systems.

RADIAL VELOCITIES DERIVED FROM THE LINE DISPLACEMENTS IN THE SPECTRA

From the instrumental point of view, the difficulties of securing satisfactory spectra for measurement were at first considerable. The spectrographs employed for stellar work and for galactic nebulæ giving bright line spectra proved quite inadequate to deal with the faint continuous spectrum of the extra-galactic spiral and elliptical nebulæ, even with prolonged exposures.

The obvious remedy was to reduce the dispersion, although this made wave-length measures more uncertain, and it was not until a scale of about 100 A. to the millimetre was adopted that satisfactory densities were obtained, with exposures from twenty to thirty hours spread over several nights.

The type of spectrum of the extra-galactic nebulæ was found in general to be very similar to the solar spectrum, the principle lines being the *H* and *K* lines of calcium, and the *G* group, with some traces of the hydrogen lines, all appearing as wide and shallow absorption lines on a continuous spectrum.

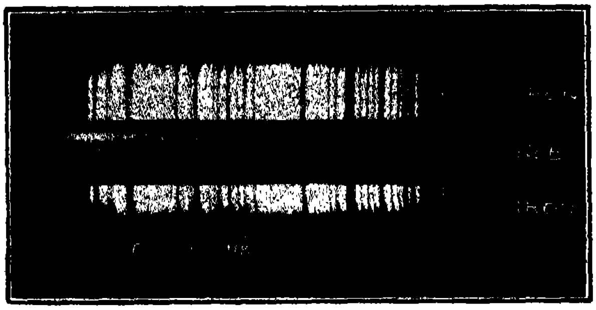

FIG. 1.—Dark-line spectrum of nebula M 81 (N.G.C. 3031) by M. Wolf, Heidelberg.

The first list of forty measured spectra was issued by V. M. Slipher about ten years ago. Among these a small group, including the Andromeda Nebula and M. 33 (the two spirals of largest angular size in the sky and probably the nearest) were found to have large displacements towards the shorter wave-lengths, and therefore considerable velocities of approach. These, with one exception, were all in the south galactic hemisphere in the same region of the sky.

On the face of it, this seemed to raise a serious difficulty, for, according to the hypothesis, it was impossible to have expansion and contraction existing together. The discovery later of the rotation of the galaxy by Dr. Oort, and its subsequent confirmation, furnished a simple explanation of these negative velocities, as the term introduced was a large one, about 280 km./sec., and in the right direction. At the same time, it is as well to state that considerable discrepancies have occurred in the measures of the nearer as well as the farther nebulæ. As an example of this, the first measures of the radial velocities of the Andromeda Nebula and M. 33 gave values of −300 km./sec. and −260 km./sec. respectively, while the latest measures of these two spirals give much smaller values, namely, −220 km./sec. and −70 km./sec.

If the galactic rotation is responsible for these velocities of approach in the south galactic hemisphere, one would expect a similar effect on the nearer spirals of large apparent angular diameter in the north galactic hemisphere, so long as they are similarly situated in galactic latitude and longitude. There are two objects which conform to these conditions, M. 81 (N.G.C. 3031) and N.G.C. 2403. The velocity shift of the first has been measured and is of the right order, −30 km./sec. N.G.C. 2403,

which should show a much larger negative velocity from its position, has not yet been included in the lists of radial velocities.

Since 1928 the question of line displacements has been taken up at Mount Wilson by Hubble and Humason, and the number of known displacements very greatly extended by the inclusion of fainter, smaller, and more distant objects. Special spectrographic apparatus had to be contrived for dealing with these faint nebular images in the 100-in. reflector. For some of the previous work a dispersion of 170 A. per millimetre was found to be concentrated enough, but this was replaced by a dispersion of 340 A. per millimetre.

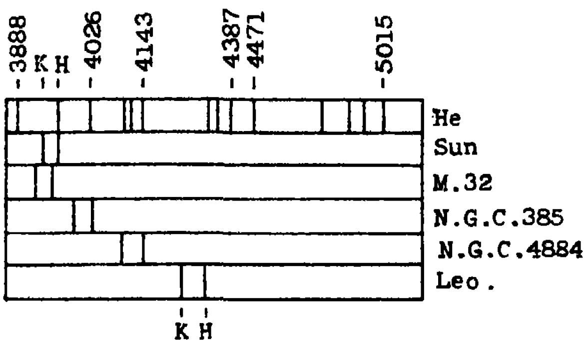

FIG. 2.—Measured displacements of the *H* and *K* lines.

In its turn, this also was discarded for an even smaller dispersion for very faint nebulæ. With a spectrograph objective of F/0·6 designed by Dr. W. B. Rayton, two prisms gave a dispersion of about 418 A. per millimetre at λ4500, and one prism 875 A. per millimetre. The uncertainty of the result with the last-named is claimed to be not greater than 300 km./sec., which is small compared with the line displacements. The highest velocity yet measured was found in a cluster of small elliptical nebulæ in Leo, where the displacement in the brightest member was equivalent to the stupendous rate of +19,700 km./sec.

The small scale of the spectrum is naturally a disadvantage so far as measurement is concerned, but a well-defined comparison spectrum of helium above and below the nebular spectrum gave a series of wave-length positions quite accurate enough for the purpose.

THE DISTANCES OF THE EXTRA-GALACTIC NEBULÆ

The great difficulty in correlating the radial velocities derived from the spectra with distance has been the lack of a definite scale of distances. Until a few years ago, even the order of distance was only a matter of conjecture, but the discovery by Hubble of Cepheid variables in the outer regions of the Andromeda Nebula gave at last a basis for a definite estimate of the distance of this system.

The previous work of Shapley and others had shown that a relationship existed between the absolute magnitude of these stars and their period. Those of short periods of a day or less are of considerably less intrinsic brilliancy than those of much longer period. All the Cepheids found by Hubble were of the longer periods, corresponding to the stars of greater absolute magnitude, those of shorter period being presumably too faint to be detected. As a first approximation the distance of the Andromeda Nebula was determined as a million light-years, and a similar investigation of M. 33, a neighbouring formation in the sky containing well-defined masses of stars, led to a slightly less distance. The Cepheid variables are undoubtedly the most reliable guide to distances, but there are other types of stars to which absolute magnitudes can be assigned within wider limits. Such are O type stars of very high surface temperatures, B type of temperatures of about 15,000 C., novæ which have occurred from time to time in the nuclear regions, and others. These were also found to exist in the two nebulæ mentioned. Linked up with the Cepheids they gave a reasonably consistent result. Estimates of these and other spiral and elliptical nebulæ were also made by Lundmark of Uppsala and agreed in general with those obtained by Hubble.

Later a list of the eight nearest nebulæ was compiled by Hubble, based on magnitude observations

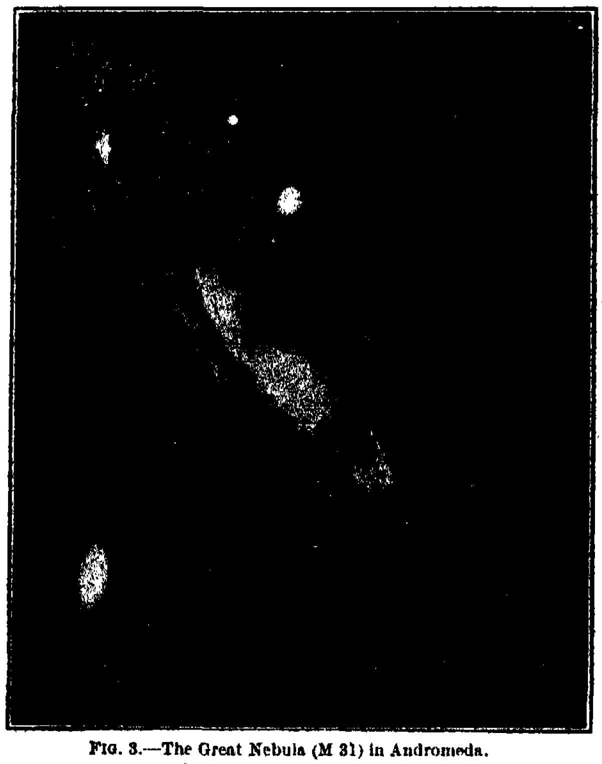
FIG. 3.—The Great Nebula (M 31) in Andromeda.

of involved stars of known types and including the two Magellanic Clouds which were regarded as irregular extra-galactic nebulæ.

For more distant nebulæ in which faint stars were actually detected but the types of which were unknown, Hubble adopted the principle that there is an upper limit to intrinsic stellar luminosity, and that observed differences in magnitude of these faint stars in various nebulæ give a rough guide to differences in distance.

Unfortunately, discrete star discs can be more easily detected in the condensed or later type of spiral than those having an amorphous bright nucleus and a varying amount of outer condensation. Out of a total of 31 nebulæ of the type of the Andromeda Nebula, 19 gave negative results, while out of 30 of the condensed type of M. 101, 22 gave positive results. This means that for two objects of different types, comparable so far as diameter and distance are concerned, one would probably show star discs and the other would not.

Some other criterion, therefore, had to be adopted. The most obvious was the angular diameter, which on the average would vary directly in inverse ratio to the distance for any particular class of nebulæ.

The difficulty of getting a reliable scale of distances, either by the integrated light of the nebulæ or the diameters, is very well exemplified by taking the two spirals of largest angular diameter in the sky—M. 33 and the Andromeda Nebula (M. 31). The distances of both have been well determined by Hubble from the Cepheid variables involved, and come out as follows :

FIG. 4.—Spiral nebula M 33 photographed with 60 in. reflector at Mount Wilson.

	Distance in 10^6 parsecs.	Diameter.	Estimated Visual Integrated Magnitude.
M 33	2·36	80′	7
M 31	2·47	140′	5

(One parsec = 3·259 light years.)

M. 31 is thus more than half as large again in angular diameter, and its total integrated light six times that of M 33, yet it is actually more distant, although the difference is comparatively small.

Of course, if a great number of nebulæ of either the spiral or elliptical type are taken, the diameter and integrated luminosity together would give a rough scale of distances, but the distances of particular objects might be out by as much as 40 per cent.

FIG. 5.—N.G.C. 3379, a typical elliptical nebula.

Hubble and Humason prefer to adopt total luminosity alone as a criterion for the nebulæ in which no stars are visible, on the ground that while increased exposure systematically extends the linear dimensions on the plate up to a superior limit, the percentage of increased diameter is much greater than the percentage of total luminosity, as there is normally a great concentration of luminosity in the nuclear regions. But in any event, it is obvious that the great trouble in arriving at a satisfactory scale of distances is the lack of homogeneity in the observational material. Even for the same objects the integrated luminosity obtained by photographic out-of-focus images differed by as much as three magnitudes in the results obtained at Mount Wilson and Harvard respectively. In the clusters of elliptical nebulæ, which must be of the same order of distance, there is a range of four magnitudes between the brightest and the faintest, so here integrated luminosities would be anything but a sure guide.

CORRELATION OF RADIAL VELOCITIES AND DISTANCES

Notwithstanding the unsatisfactory nature of the scale of distances, Hubble established in 1929 that there is a general correlation between radial velocities and distances of something like 500 km./sec. per million parsecs. The following lists give some typical examples :

ESTIMATED DISTANCES AND EQUIVALENT RADIAL VELOCITIES OF THE EIGHT NEAREST KNOWN SYSTEMS

System.	*R.*	*V.*	*L.*	*B.*
Nubecula Major .	0·262	+170	245°	−35°
Nubecula Minor .	0·290	+290	265	−40
N.G.C. 6822 . .	1·92	−130	350	−19
M. 33 . . .	2·36	−70	101	−31
M. 31 . . .	2·47	−185	87	−22
M. 101 . . .	4·0	+200	116	+58
N.G.C. 2403 . .	6·3	..	62	+28
M. 81 . . .	7·3	−30	107	+39

R. = distance in parsecs × 10^6.
V. = equivalent velocity displacement.
L. = Galactic Longitude.
B. = Galactic Latitude.

The distances given here are based on the Cepheid variables, except the two last, where stars of other types are used as gauges.

The solar galactic rotation effect, found by Hubble to be about 280 km./sec. with its apex in galactic longitude 32° and latitude + 18°, introduces large corrections in most of the above. Taking this into account, all the negative velocities disappear, and we are left with a quantity which represents a combination of the expansion rate and the peculiar motion of the system.

In the next table the solar galactic rotation effect is smaller compared with the velocities. Representative systems only are given, as the total number now known altogether is over eighty.

Here the radial velocities have already been corrected for the galactic rotation.

The distances have been estimated from involved stars of the 18th magnitude and fainter, the types of which are unknown. These stars are taken as representatives of maximum intrinsic luminosities.

System.	R.	V_s.	Mn.	Ms.
N.G.C. 5236 .	0·9	+500	10·4	18·5
3627 .	0·9	+850	9·1	18·5
1068 .	1·0	+920	9·1	18·7
7331 .	1·1	+500	10·4	19·0
4258 .	1·4	+500	8·7	19·5
4151 .	1·7	+960	12·0	20·0

Mn = integrated nebular luminosities.
Ms = stellar magnitudes.

Past this point stars are no longer available as criteria of the more distant systems, so reliance has been placed by Hubble on the integrated visual or photographic magnitudes of the nebulæ themselves. If we take a hypothetical nebula of average total intrinsic luminosity and imagine it removed to twice the distance, its diameter would of course be halved and its total luminosity reduced to a quarter.

As the ratio between one stellar magnitude and the next is 2·512, it follows that a decrease in luminosity of one magnitude would be equal to an increase of distance by 1·58. This is therefore the equivalent ratio in the following table, where integrated magnitudes take the place of estimated distances. Large discrepancies are inevitable in such a procedure, as the results show.

As a final test of the validity of the expansion factor for very distant objects, Hubble and Humason examined certain of the brighter nebulæ which appear in isolated groups. The great majority of these are of the small elliptical type, showing no spiral structure. Some nebulæ in the Virgo group, which would perhaps be better described as a concentration in the line of sight, gave largely different velocities, but the general results were such as to give ample support to the expansion hypothesis.

From the data given, Hubble and Humason adopt a round figure of 560 km./sec. per million parsecs as the velocity-distance relation. Although the whole investigation was necessarily based on indeterminate and to some extent arbitrarily selected material, the relation seems to be a reality. The velocity ratio found can scarcely be regarded yet as more than a first approximation, but it is of the right order.

Fig. 6.—Field of elliptical nebulæ by 100-in. reflector at Mount Wilson. R.A. 3 h. 12 m. Decl. +41° 8′ (Perseus).

System.	V_s (corrected for solar motion).	Mag. Vis. or Phot.
N.G.C. 4051	740	11·9
3227	1090	12·0
7217	1250	12·3
2859	1450	11·1
2950	1560	11·6
3010	1950	11·8
6703	2280	13·6
6702	2530	14·6
6359	3250	14·3
6661	4170	14
6710	5380	15

Group.	Number.	Range of V_s km./sec.	Mean Photr. Integrated Magnitude.
Virgo . .	7	600-1170	12·5
Pegasus . .	5	3500-4000	15·5
Pisces . .	4	4460-4960	15·4
Cancer . .	2	4670-4970	16·0
Perseus . .	4	4800-5800	16·4
Coma . .	4	5100-8000	17·0
Ursa Major (Baade 24)	1	11800	18·0
Leo . . .	1	19600	19·0

A question has been raised as to the proper interpretation of the observed displacements of the

spectral lines. Is the Doppler effect the only possible interpretation? If the slowing down of light over vast distances is a possibility, shifts towards the red would be expected—indeed, de Sitter's original cosmology suggested this as alternative or complementary.

A letter to NATURE of Jan. 16, 1932, from Prof. W. D. MacMillan, suggests that the red shift is due to loss of energy in the photon in course of time, due either to inherent instability or collisions with other photons. He concludes: "Such an interpretation of the extraordinary shifts that are observed will be more acceptable to many than an interpretation which makes our galaxy a centre from which all others are fleeing with speeds that are proportional to the distances".

Canons of Archæological Theory *

By Dr. DAVID RANDALL-MACIVER

FROM a vast and intricate subject I will select for discussion only two of the principal problems of archæology—namely, the application of a time-scale and the proof of the dissemination of a culture. First, then, as to the time-scale. A series of culture periods has been well established, so that there is a reliable system of what is called 'relative chronology' from the earliest Stone Age down to the time of full documentary history. But it is a very different matter when we attempt to translate these culture periods into centuries and thousands of years. We are wholly dependent for our absolute chronology upon the dates recorded or obtained by immediate inference from ancient writings or traditions. The fragmentary relics of Mesopotamian and Egyptian official chronology furnish a time-scale, liable to much uncertainty in minor details, but trustworthy in all its main lines. As archæological discovery proceeds in the coming years, we may reasonably hope to arrive at a completely graduated scale of chronological dating in actual years for every part of the ancient world after 3500 B.C. But if it is asked what means we have for establishing a chronological as well as a typological scheme behind 3500 or possibly 4000 B.C., I answer unhesitatingly that we have none, and that unless earlier written records or traditions come to light it is probable that we shall never have any.

One very crude method of attempting to avoid this impasse is so illogical that I need spend little time in discussing it. Below the strata in which definitely datable objects are found—whether at Knossos, Ur, Susa, Mohendjodaro, or any other very ancient site—there are generally strata of a certain thickness in which other and obviously earlier forms occur. Now, it is sometimes suggested, even by skilled explorers in their less discreet moments, that the mere thickness of these undated layers may give an indication of the length of time which it took to form them. Yet a very slight amount of reflection, not to speak of actual experience in the field, will show that this reasoning is as childish as it is simple. I have myself seen in Egypt deposits many feet deep which can, nevertheless, be proved, by well-dated objects at the top and bottom, to have been formed within a single century; and I have also seen a concentrated stratum of not more than four feet which contained the products of many centuries closely pressed together.

In a less crude but not very different form, the same error appears in the attempt made by several justly admired writers to establish a chronological scale for the typological series preceding the historical in a country like Egypt. The system of sequence-dating based on typology is now familiar to all students. It was established for Egypt by Sir Flinders Petrie, and for Europe in general by Montelius. As a scheme of relative chronology it sometimes creaks a little, but on the whole it works well and has justified itself, though it may need occasional emendation. But the recurring attempts made by one author after another to translate this relative system into an absolute chronology of years have no logical justification whatsoever, and only encourage self-deception.

The argument is really based on an assumption which can easily be shown to be fallacious. This is the assumption that the rate of progress in civilisation is always uniform. If we know the rate of development in types which took place during the First and Second Dynasties and know also from inscriptions the length of these dynasties, then, it is argued, we have a yard-stick which can be applied to the period preceding the First and Second Dynasties. It is as though a policeman, having timed a speeding motor car over a measured mile, and found that it was going at sixty miles an hour, should appear before the magistrate and state that it was evident the defendant had been proceeding all day at sixty miles an hour.

If, however, we must abandon such illegitimate methods, it is not quite impossible that properly directed ingenuity may find some others which will give a rough scale, less accurate indeed than the chronological, but, nevertheless, valuable. The recent success of Miss Caton-Thompson in settling the very difficult dating of Badarian culture by truly logical methods based on geology is very encouraging; and thirty years ago I myself made a suggestion which I still think has some value. If, I suggested, we could discover the village corresponding to an ancient cemetery, and also ascertain the total number of burials in that cemetery, then we should be able by calculating the presumable death-rate to arrive at a rough estimate of the number of generations. It is evident that several factors in this equation can never be established more than approximately, but it would be worth attempting, if ever a suitable site could be found.

Next we may briefly consider the problem of the dissemination of cultures. This is really the cardinal

* From the presidential address to Section H (Anthropology) of the British Association, entitled "The Place of Archæology as a Science, and Some Practical Problems in its Development", delivered at York on Sept. 2.

problem of archæology, irresistibly attractive, and for that very reason offering peculiar temptations to hasty and premature generalisation.

Now, the foundations of this particular study, in so far as they have been well and truly laid at all, have been laid not by archæology but by other sciences, those in fact which deal not with man himself but with the conditions necessary to his very existence. Geology, climatology, palæontology, palæobotany have been the instruments of that great progress in synthetic theory which I have pointed out as the special achievement of the last thirty or forty years. Those who have worked out the details and the stages of the Ice Age and the rainy periods have shown us that various parts of the world were uninhabitable for a long time. It is obvious, for example, that man cannot exist under a snowfield, so that it is useless to look for him north of lat. 50° until the Ice Age is well past.

Conversely, large areas which to the modern view seem impossible homes for man are shown to have been eminently suitable for the life of the palæolithic hunter. The Sahara and the Gobi desert in their present condition cannot maintain the life of man or beast; but the climatologist shows that there was a not very remote period when they were well-watered regions, covered with grass like the South African veldt, and teeming with large game. Thus he explains what otherwise might have remained an ambiguous problem for the archæologist, the finding of human implements of very early types in these apparently uninhabitable tracts.

The botanist next comes forward to tell us that the food plants on which a settled agricultural life depends can only be found in their wild state in certain closely defined areas. He also shows how changes of climate produce various types of afforestation which necessarily limit the movements and activities of a man who possesses only primitive tools.

But when the archæologist proceeds by purely archæological methods to fill in the details on a background of which the outlines are thus immutably drawn by the other sciences, he is confronted with innumerable difficulties of method, and the logic of his procedure is not always well studied. In the first place, we must necessarily rule out many types of reasoning which are so general and inconclusive that they can never carry any conviction. A little serious reflection must show that we necessarily know so little of the mental equipment of early man that it is often impossible to say what actions and habits are natural to all men as highly developed anthropoids, and what are so peculiar as to be specifically human and characteristic of one or another developed type of man.

That man should seek shelter from the elements is so obviously natural, and so like all other animals, that probably no one would argue that the living in caves or the construction of a primitive shelter, analogous to an animal's lair or a bird's nest, must presuppose any identity of race or origin. Or again, may not any animal pile up stones? And if so, at what exact stage does the piling up of stones become such a complex action that it can only be developed in one place? Suppose that a shelter of stones has to be roofed. Is the laying of slabs, one overlapping the other so as to form a corbel, so intricate a device that it might not be invented in many places simultaneously? It seems a very primitive process, even if it has been developed with great skill in certain countries.

It has sometimes been suggested that the discovery of the uses of burned clay, and consequently of baked pottery, may have been due to the accidental firing of a wattled hut. If so, it is difficult to maintain that the invention of pottery could only happen in one place, unless the use of fire was limited to one little spot on the earth.

These apparently elementary questions go to the root of the whole matter. Whatever answer an archæologist might give, he could not persuade by logical means any opponent who chose to disagree with him. He would be obliged, when driven into a corner, to say, "I am convinced" of this or that, but the conviction would express nothing more than his own temperament and psychology.

To apply logic at all, then, we need to find our material in highly specialised products or habits of man. In short, it is only possible to reason convincingly when manufactures or arts and crafts have reached a high point of intricacy. Let us take examples from flint-working, man's earliest craft. It seems fair to say that the use of natural flints, perhaps even of pre-Chellian or rostrocarinate and other forms which involve the minimum of workmanship, might arise independently among various types of almost simian man. But when it comes to elaborate chipping, and when this chipping produces implements of identical and highly specialised forms, then it is indeed logical to argue that this process and these forms could only have been invented once and only in one region. Chellian flints already seem to me to be so distinctly a product of a highly specialised intelligence, which might have taken a hundred other forms, that it must inevitably be inferred that a single type of man originated these artefacts, even though they are found distributed over an immense area.

Still more it might be supposed that when one more degree of elaboration has been added, by the use of so peculiar a technique as pressing off flakes as well as chipping, the logical inference was still stronger. If, further, this peculiar technique is combined with peculiar shapes, then the case seems to be almost irresistible. To accept this would entail some surprising consequences, linking, for example, the Badarian culture of earliest Egypt with the Solutrean of Europe and perhaps with other even remoter places. Yet it is certainly good reasoning. It is curiously significant, however, of the difficulty of arriving at any certain conclusions that just as we might be ready to accept this theory of the Solutrean, with all its far-reaching consequences, Menghin comes forward with the assertion that the Solutrean style is the natural and inevitable product of the juxtaposition of a core-working and a flake-working industry.

In contrast to the doubts and uncertainties which beset all reasoning based on the manufactures and

products of early man, it is a relief to turn to a field in which unquestionable logical certainty can be achieved. This is when we are able to study man's action in moving and displacing natural products. For when the natural distribution, as known to geologists, of rocks, ores, and other natural products is artificially changed, there can be no doubt that man has been at work. Thus, if a certain kind of flint is peculiar to Grand Pressigny in France and implements of that flint are found in Switzerland, there can be no doubt that Switzerland is trading with Pressigny. Similarly, if gold combined with antimony is known only to occur in Transylvania, it is a just, though a surprising, inference that the sceptre of a very early Egyptian king, living about 3000 B.C., which shows this unique combination of metals, is made of gold from Transylvania. To take a simple example from nearer home: if a number of stones in the circles of Stonehenge are of a type peculiar to Wales, they must have been transferred from Pembrokeshire to Salisbury Plain by man.

Raw materials, then, are better evidence than manufactures, especially in the earlier stages of man's life. When we are dealing with the works of man, logical processes of real value only begin to be applicable as handicrafts become more complicated and as the arts begin to emerge. Between art-styles, if we are sufficiently discriminating, it is possible to institute sound contrasts and comparisons. To take an extreme example, we should no doubt recognise a Greek statue even if it were found in West Africa. The hammer-axes of Troy and the Danube, the polygonal battle-axes so widely spread over southern Russia and northern Europe, the lunulæ of Irish gold, the decorated situlæ of Iron Age Italy, the painted vases of pre-Corinthian style, may stand as examples of highly specialised products which unquestionably denote commerce and reciprocal influence wherever they occur.

We have to be on our guard, however, against many cases in which the style is scarcely developed enough to be a convincing criterion, or in which the style has become so confused owing to cross influences that it gives an ambiguous answer. Most of all does this occur in the sphere of pottery. There is more bad reasoning in regard to pottery than in regard to any other part of our subject.

Especially in such early stages as the Neolithic and the Chalcolithic, there is the same danger of reasoning in too general terms that I have already pointed out in regard to primitive customs and habits. The smaller vessels used during the Neolithic stage are all imitations in clay of receptacles originally made in other materials. Goatskins, leather bags, gourds, and baskets are some of the natural predecessors of pots. It is only to be expected, therefore, that the clay imitations of these will be found far and wide among people who may have had no racial connexion or commercial intercourse of any kind. It is only occasionally that geographical conditions may intervene to prove that there is a real unity of culture underlying the superficial resemblances. There is, however, one happy instance of this. Gourds are indigenous in tropical and semi-tropical countries, but do not grow naturally in Europe. When, therefore, pots derived from gourd-forms are found in Moravia, it is a logical and necessary inference that the people who made them on the Danube came from a gourd-producing country like Asia Minor, or were in close commercial relation with it.

In this connexion, I should like to contrast two examples of reasoning, one of which has led to useful and fruitful results, while the other threatens to plunge us into confusion. All archæologists are agreed that the beakers which have such a wide distribution over Europe in the Bronze Age are derived from a single source, though they are not unanimous as to the centre of origin. This unification of a single system all over the west and north of Europe, including Great Britain, has greatly assisted the study of the Bronze Age in those regions. But contrast with this the attempts which are being made to unify the schools of painted pottery so as to make a chain from Chalcolithic Sicily to China. The dates are hopelessly incompatible over large sections of this immense area, the civilisations have few if any points in common, and yet we are invited to unify them on the sole basis of paint being used. It is even asserted in so many words that it is improbable that the idea of applying paint to pottery should arise independently in different centres. It might be too dogmatic to say that this is utterly illogical, but it can certainly be said that it is quite unconvincing. The discovery of paint is in itself easy and inevitable, and once this medium is known, it will naturally be used for anything and everything.

This leads me to make, in conclusion, the only suggestion that I think need be made in regard to the training of the young archæologists of the coming generation. I do not believe that early specialisation in archæological training would be wholesome—indeed, I think it would probably be rather harmful. As I mentally call over the roll of my most distinguished colleagues, some a little older and some a little younger than myself, I am struck with the remarkable diversity of their background and training. This diversity has probably been a real source of strength. That classical scholars, historians, anthropologists, geologists, lawyers, engineers, artists, and many other types of mind should focus from different angles on the same subjects has led to catholicity and breadth. For it is not so important that an archæologist should be an expert in one subject as that he should be widely and well educated.

With this premise once granted, I think that much time would be saved, and much efficiency would be added, if the student at the beginning of his archæological career were to superimpose a year or so of intensive technological training on his more general education. We all know the saying that a man does not really know about an object until he can make it. A technical training in primitive handicrafts such as pottery-making, flint-chipping, weaving, and the hammering, alloying, and casting of metals, would give him an insight which no mere reading or even handling of finished specimens can give.

Obituary

Sir Ronald Ross, K.C.B., K.C.M.G., F.R.S.

RONALD ROSS'S great discovery was made so long ago that it is difficult for anyone, unless he is nearer sixty than fifty years of age, to remember either the baffling mystery of malaria or the flood of light which his discovery threw not only on malaria, or even on tropical diseases generally, but also on all disease. His discovery disclosed conclusively a new method of the transmission of disease; and its practical importance was immediately recognised, as Great Britain was beginning to understand how vital it was to minimise the wastage of life involved in maintaining her Empire overseas.

Ross stated himself that it was about 1889 when he began to take his profession seriously, and he was specially attracted to the fever cases that mainly filled his hospital. As he had not heard of the work of Marchiafava, Celli, or Golgi, it is perhaps not surprising that he was unable to recognise the bodies described by Laveran. But a visit to London in 1894 brought him into contact with that other great figure in tropical medicine, Patrick Manson. Manson knew all that was to be known about malaria parasites at that time, and his penetrating mind had already decided that, in some way or another, the mosquito was the agent by which the disease passed from one man to another. Nor were his speculations merely the dreams of an idler, sitting in a comfortable arm-chair. Manson had worked in China and had there discovered two phenomena: the nocturnal appearance of the embryo of *Filaria bancrofti* in the blood of man, and the shedding of its sheath when the blood was cooled. He had wondered what all this meant. Had it any bearing on the life-history of the parasite? He had realised that this disease could not be spread by direct contact, and that some special mechanism was required to assist the parasite's escape from the human body. He rightly inferred that the mosquito was the most likely means by which that occurred. He reasoned that when the mosquito sucked blood from man, the parasites would be sucked in too, and that after living in the mosquito during its lifetime, they would escape on its death into water, from which they would again reach the body of man by ingestion.

Manson forthwith put his ideas to the test, for he was a man of action; and he saw things that convinced him that he was right. Men might tap their heads and suggest that Manson was mad in some of his ideas. I am sure he only smiled at that, for he had seen with his own eyes something that could have only one meaning, namely, that the parasites had found a congenial abode outside of man, and were growing in the mosquito. With this firmly fixed in his mind when he began to work on malaria in London, and when he saw certain strangely moving forms, he concluded that these were not due to the convulsions of a dying parasite, but were the beginnings of a new life cycle which would be spent partly in the mosquito, partly in water, and ultimately in man.

Manson told all these things to Ross; and it was decided that Ross should begin his investigation with the crescent form of parasite and try to follow the flagellum, that curious writhing thread which bursts from the crescent some time after blood has been drawn from man.

As it turned out, however, although the flagellum was the new phase of the parasite's life outside its human host, it was practically useless as a clue to the discovery of the secret. "Follow the flagellum" was Manson's advice; but the flagellum absolutely and utterly disappeared soon after it entered the mosquito's stomach, and it could be found neither in the stomach nor in any other tissue or organ of the insect. It is here that the genius of the younger man came to the aid of that of the older. For Ross had the perseverance that is required to make a great discovery, and he had the eye and mind to recognise the malaria parasite when it presented itself, strangely disguised, in the wall of the mosquito's stomach.

For nearly two years Ross hunted for the elusive thread. He dissected, he stated, more than a thousand mosquitoes, going through every possible tissue, and working out a technique that finally laid bare the parasite. What neither Ross nor Manson knew was that only a few species of anopheles carry malaria, and that in many parts of the tropics, India included, the number of the dangerous species is a very small percentage; indeed, in many places, only a fraction of one per cent of the total number of mosquitoes that buzz around and bite a man. But at last came the day when Ross had a new species of mosquito to feed. He bred it from a new kind of larva. He kept it in captivity, and he pictured in his notes the egg of the insect, which is clearly that of an anopheles. He fed it on a malarial patient; a few days later he dissected out the stomach of the mosquito by his own special technique, and there lay the malaria parasite—a tiny thing, but to the searcher's eye the thing he had sought so long and so patiently—indubitably the thing, for it had the fine grains of

pigment that the parasite in human blood contains. He had triumphed over the chief difficulties, and discovered the two unknown quantities, neither of which could have been found separately: first, where the parasite appeared in the tissues of the mosquito, and second, the kind of mosquito in which the parasite was found.

Now on the eve of complete triumph, an exasperating delay occurred. Ross was removed to a station in which there was no malaria; but thanks to Manson, he was put on to special research duty. He had learned how to keep mosquitoes alive for longer than Manson thought they lived, and he soon followed the development of the parasite through all its stages in the mosquito—the growing zygote in the stomach wall of the insect, the development of the sporozoites in the zygotes, the bursting of the zygote outwards, the spread of these sporozoites through the body juices of the mosquito, the presence of the salivary glands in the fore part of the body of the mosquito, the gathering of the sporozoites into the glands, the duct leading from the salivary glands direct to the proboscis of the mosquito, and the final and conclusive proof, the infection of healthy birds by the bite of mosquitoes containing these sporozoites in their salivary glands. Can we wonder that when Manson announced these discoveries to the Tropical Section of the British Medical Association at Edinburgh in 1898 they created a "profound sensation among the members", who stood and cheered?

To estimate the advance made by these discoveries, it is worth while for a moment to turn to what men knew of malaria when Ross began his work. Laveran had discovered the parasite of malaria. Malaria was no longer a vague mist floating over a swamp, that entered a man and caused chills and fevers, with a rhythm almost like the changes of the tide or the phases of the moon. The miasmic hypothesis of malaria was a fine conception; it explained better than any other all the facts of European malaria. It was, indeed, a very brilliant explanation of one of Nature's most cunningly hidden secrets. In Europe, it was true that malaria was a disease of low-lying swampy places, and that elevation gave immunity from the disease. But unfortunately, the explanation that fitted European malaria totally failed to explain it in other parts of the world. There, malaria was often virulent when there was only fast-running water and not a swamp within miles. Some of the most intensely malarial places were among the hills. Malaria occurred in deserts, as well as jungles; or in towns which were neither jungles, deserts, nor swamps.

Laveran gave precision to the conception of the disease, but did not show how it spread from man to man, although he had suggested that it might be carried by the mosquito. There were speculations and observations and experiments in abundance. Air, earth, and water were searched. Every excretion of man was examined: and claims were made that we now know were false. King in 1883 suggested that the mosquito picked up malaria in a swamp and infected man when it bit him, and gave nineteen reasons for this supposition, some of which were attractive and true within limits. Smith and Kilborne showed conclusively that Texas fever of cattle was caused by *Piroplasma bigeminum*, a blood parasite with some resemblance to the malaria parasite, and that it spread by means of the tick; but they failed to discover the parasites in the tick, and still less to demonstrate an elaborate life-history like that of human malaria in the mosquito. Manson thought the mosquito received the disease from man; that it died on water, and that man became infected either by drinking infected water or inhaling infected dust. Manson failed to prove that mosquitoes transmitted disease, because, even for so large a parasite as the *filaria*, his method and technique were at fault: method and technique being to science what organisation is to business, and at times even more essential.

In the long and arduous search, Ross had nothing to help him but his own indomitable perseverance and the genius to recognise what he saw. Had he not persevered and won through, the secret might have been a secret still. What a difference that would have made. If Manson could say that in some measure his only claim was he had discovered Ross, in like measure it might be said that Ross discovered to the world the genius of Manson. I can imagine the Goulstonian lecturer of 1998 referring to Manson and Ross, tracing their researches and discoveries, and the subsequent discoveries of the transmission of yellow fever, trypanosomiasis, tick fever, typhus fever, and other diseases by insects, and then asking his audience to think what a happy chance brought these two great men together.

Ross was happy in his great discovery. He was pleased at the honours he received. They were the highest the academic and scientific world could give. But he was never unduly elated, and he never forgot and never ceased to say that his work was not done for the sake of science, but for the sake of his fellow-men.

It was a bitter disappointment that the world made so little of the knowledge he gave it. With his far-seeing mind he realised that by his discovery the work of prevention was not ended,

but only begun. Even in the hour of triumph, when the shouts of victory might have distracted him, he wrote, in the very first paper he published after the discovery, that the way of progress was by further "experiment and research". It was, however, to be "experiment and research" on a scale larger, in time and space, than the medical profession had visualised, and the results have come in slowly for that reason; but solid progress has been made, and Ross's last birthday was brightened by good news from Africa about the development of the work to which he had devoted his genius and his life. Then clouds closed over one of the most active minds of his generation one of the foremost men of science of his time and on one of the great benefactors of mankind. He died at the Ross Institute, London, on Sept 16, 1932.

MALCOLM WATSON.

News and Views

Sir Ronald Ross

FOR many weeks the thoughts of scientific colleagues everywhere, as well as those of a large group of the lay public, have frequently turned to the bedside of Sir Ronald Ross where he was lying grievously ill. All who knew Sir Ronald personally cherished the hope that they might again be privileged to meet him, though in their minds they knew that such an event was unlikely. The parting came on Friday last, when he crossed the dark river into the land of silence. To few men have such brilliant and intellectual attributes been given, and none has had greater influence upon the comfort and welfare of the human race. The versatility of his genius was really remarkable. Not only was he the author of several mathematical works of high order, but his volumes of verse showed him to possess rich talents of poetic conception and expression. His scientific work is appropriately surveyed on p. 465 of this issue by Sir Malcolm Watson, director of tropical hygiene and principal of the Department of Malaria Control at the Ross Institute and Hospital for Tropical Diseases, where Sir Ronald Ross died. We are fortunate in being able to publish this appreciation from one who did so much to apply the results of Sir Ronald's investigations to anti-malarial measures in the Federated Malay States, Singapore, and elsewhere, and has been closely associated with him at the Ross Institute for several years.

SIR RONALD ROSS was born on May 13, 1857, at Almora, India, and after being educated at a private school, studied medicine at St. Bartholomew's Hospital, and entered the Indian Medical Service in 1881. His investigations on the life-history of the malarial parasite and the means of preventing malarial infection began with a clue indicated by Sir Patrick Manson. When Ross first attacked the problem in 1895, at Secunderabad in India, the circumstances entailed much difficulty and many delays. Here he opened up an investigation as to whether the malaria parasite, discovered by Laveran, passes part of its life-history within the body of a living insect. After more than two years of fruitless experiments, Ross discovered a stage of the human malaria parasite in the tissues of the mosquito, anopheles, which had been allowed to feed on the blood of a malarial patient. In 1898 he proceeded to work out in detail the life-history of the malarial parasite found in sparrows and larks in India. He traced the stages in development of this parasite from its inception into the stomach of the gnat, *Culex fatigans*, which feeds on the blood of these birds, to its passage back into their blood through the secretion of the poison gland of the insect. Thus he furnished conclusive experimental proof of the part played by the insect in propagating the infection. Ross was elected a fellow of the Royal Society in 1901, and in 1909 was awarded a Royal medal of the Society. He was awarded the Nobel prize in Physiology and Medicine in 1902; and national recognition of his work is represented by the honour of K.C.B. conferred upon him in 1911 and K.C.M.G. in 1918.

Egypt Exploration Society's Jubilee

BY exhibiting two relatively small collections of objects and manuscripts from the many thousands presented to the British Museum by the Egypt Exploration Society during the fifty years of its existence, the authorities of the Museum have fittingly marked the jubilee of the Society and once more reminded the public of the way in which the national collections have been enriched and the sum of the nation's wealth increased by the benefaction of private effort. Yet the objects which may be exhibited in the collections of a museum, however intrinsically valuable, priceless for their rarity, or instructive as a means of re-creating the history or the everyday life of a vanished civilisation, represent but a part of the achievement of an association of private individuals engaged in the common pursuit of the scientific exploration of the obscurer phases of the early history of mankind. A year or two ago, when the Society for the Promotion of Hellenic Studies celebrated its jubilee, its services to the cause of classical scholarship and the study of early Mediterranean culture were duly recognised. The Egypt Exploration Society, having in view its wider appeal, may justly claim an even greater achievement. With no assistance from public funds, it has brought to light, restored, and handed over to the Egyptian Government in trust for future generations some of the most impressive of the monuments of Egypt's past, such as the temples of Deir el-Bahari, the Osireion, and the tombs of Beni Hassan, while its most recent excavations in a humbler, but historically no less instructive, sphere at Amarna have revealed the material surroundings and dwelling-places of the general population of an Egyptian city.

THE activities of the Society in excavation have afforded an opportunity to many well known in the archæological world for the exercise of their skill. The list would be too long to recite, but the names of Petrie, Naville, Hall, Hogarth, Hunt, Grenfell, and Woolley in this connexion immediately leap to the mind. Their work has been recorded in the scholarly and beautifully illustrated publications of the Society. In the collections now specially exhibited in the Egyptian Galleries and the Manuscript Saloon of the British Museum may be seen some of the choicer relics excavated by them. These have been given to the Museum, it should be added, as the agreed method of disposal of the finds allotted for the share of the expenditure raised by subscription from private individuals. Over two score manuscripts, which include the priceless "Sayings of Jesus", new poems by Sappho and Bacchylides, and the text of Pindar's "Pæans", are shown. Among the more striking archæological exhibits are the polychrome glass fish from 'Amarna and the sandstone sphinx inscribed with the famous pictographic script of Sinai, both of which have attracted much attention from the public, the diminutive gold statuette of Re, and the silver shrine from Daphnæ. With a number of exhibits of decorated glazed ware discovered at Amarna in the last two or three seasons' work is the unique Eighteenth Dynasty ivory *ushabti* from that site, whence also comes, among the finds of the season just past, the remarkably fine engraving of a young king's head on limestone, while the limestone head of a bald-headed old man, shown near by, comes from Deir el-Bahari. The relics from the recently discovered Buchæum, the temple of the Buchis bull cult, are here on exhibition for the first time. The larger objects and statues in the Gallery, for which the Museum is indebted to the Society, have been specially labelled.

Old and New Pharmacy

A WRITER in the Sunday *Observer* recently deplored the passing of the old-time English pharmacy with its window display of stoppered carboys of coloured water and its opal and gilded drug-jars. The loss of these emblems coincides with a change in the character of the pharmacist's occupation. The centralisation of manufacture tends more and more to convert him into a distributor of compounded medicines, in place of the skilled technician who made his own preparations out of crude drugs; but it must not be forgotten that he must now know a great deal more, about more complex drugs, than the old-time pharmacist. Side by side with this change there has grown up a demand on the part of pharmaceutical and fine chemical manufacturers for a new kind of pharmacist, whose knowledge is varied enough to enable him to deal with the new developments in therapeutics to which chemists, pharmacologists, and physiologists are constantly contributing. Much the same type of pharmacist is required by the great hospitals, which in these days often undertake the manufacture of pharmaceutical products on a considerable scale, for the use of their patients. To meet these new demands pharmaceutical education in Great Britain has been and is still being remodelled, and if any justification is needed for the changes the Pharmaceutical Society is making in this direction, it will be found in the new "British Pharmacopœia", to be published next month. The advance notices of this work, which have appeared in the technical press, indicate that it will make greatly increased demands on the knowledge and skill of the pharmacist, even where he is only concerned with the care and distribution of the vast number of products used in modern medicine.

British Pharmaceutical Conference

IN these circumstances it was peculiarly fitting that the chairmanship of the annual meeting of the British Pharmaceutical Conference at Aberdeen should have fallen this year to Mr. Herbert Skinner, the veteran pharmacist of the Great Northern Hospital and a former president of the Pharmaceutical Society of Great Britain. In his opening address, Mr. Skinner deplored the tendency, which exists even among medical men, to regard the hospital pharmacist as merely a dispenser of medicines, and out of his own rich experience drew an interesting picture of the duties and responsibilities attached to such a position, in the course of which he insisted on the necessity of maintaining a laboratory in every pharmacy, if the pharmacist is not to lapse into a mere distributor. The number of papers contributed to the Science Section of the Conference was twenty-nine, which is stated to be a record. It is perhaps to be expected in a year which sees the advent of a new "Pharmacopœia" that these papers should be largely concerned with methods of analysis of drugs. The importance of this kind of work is obvious, since upon it depends control of the purity and strength of drugs, but it is to be hoped that at future Conferences there will be more papers of the type contributed by Dr. Linnell and his colleagues on the synthesis of pressor substances and local anæsthetics, since these imply the development of interest in the synthesis of new drugs in Great Britain.

New Zealand Earthquake of Sept. 16

SINCE Feb. 3, 1931, the strongest earthquake in the Hawke's Bay district is that which occurred at 1·30 A.M. on Sept. 16. In 1931 the principal damage was confined to Napier, Hastings, Waipawa, and other places lying within an elongated area about fifty miles in length and directed north-north-east. The earthquake of Sept. 16, though much less intense and unaccompanied by loss of life, was strong enough to cause slight damage, such as the partial collapse of some houses at Wairoa and Gisborne, to the north of Hawke's Bay. These places lie nearly along the continuation of the areas mainly shaken in 1931, but the centres of the two meizoseismal areas are separated by about eighty miles. The point of chief interest about the recent earthquake is the continual migration of the focus in the north-north-easterly direction from 1855 until 1931 and again until Sept. 16 last.

Henry Cavendish

WITH reference to a paragraph which appeared in these columns in the issue of NATURE for Aug. 6 (p. 198),

in which the ascription of the title 'Honourable' to Henry Cavendish was described as a persistent delusion, Dr. E. J. Holmyard writes: "This stricture appears to be based upon a misapprehension. It is only within the last hundred years that the title 'Honourable' has been conventionally limited to the children of peers below the rank of marquis, and that it was commonly given to Cavendish is shown both by the admission register of Peterhouse (where he is described as 'Honorabilis Henricus Cavendish') and by the fact that Wilson's 'Life' (London, 1851), written when many of Cavendish's contemporaries were still living, employs the title without comment." Dr. Holmyard, however, will find that the definition of the term given in early reference books (for example, "Encyclopædia Britannica", 3rd ed., 1797) is exactly the same as the one in force to-day, and allows no excuse for the ascription to Cavendish. Cavendish's father, Lord Charles Cavendish, was not a peer, and however loosely the term might have been used and accepted in those days, it seems quite clear that Henry Cavendish had no right to it, and that it was incorrectly applied to his name and has been as incorrectly accepted without question until now.

League of Nations Intellectual Co-operation Organisation

THE International Institute of Intellectual Co-operation (2 Rue de Montpensier, Paris I) has just published the first number of a new monthly *Information Bulletin*, as the official organ of the League of Nations Intellectual Co-operation Organisation, which comprises a committee of the League with its secretariat at Geneva, the Institute in Paris, committees of experts, and national committees. It is a counterpart in English of the Institute's *Bulletin de la Coopération intellectuelle*, most of the contents of which will be summarised in it. This first number contains a review by the director of the Institute of recent developments in this field, special articles on the reorganisation of education in China and on "Moral Disarmament", a summary of the month, reports of meetings held under the auspices of the League's Organisation, and notices of forthcoming congresses. A foreword by Sir Eric Drummond commends it to the notice of all those who are interested in the promotion of international co-operation in art, education, science, and scholarship and believe that its progressive development is an essential condition for the gradual realisation of the principles for which the League of Nations stands. The annual subscription is 10 shillings or 2 dollars: single copies, 1 shilling or 20 cents.

Soil Physics in Relation to Meteorology

DR. B. A. KEEN, of the Rothamsted Experimental Station, discussed "Soil Physics in Relation to Meteorology" at the G. J. Symonds Memorial Lecture for 1932 of the Royal Meteorological Society (*Q. J. Roy. Met. Soc.*, July). This new branch of physics has made it necessary to discard a number of generally accepted explanations of agricultural and horticultural matters connected with the soil. Russian work on soil classification has, for example, led to the recognition of certain soil groups as a basis for a survey of the soils of the whole world, and it is found that the type of soil formed in any place is dependent not so much upon the geology of the neighbourhood as upon certain meteorological factors, especially temperature and rainfall. Analysis of vertical sections of the soil, or soil 'profiles', shows unmistakably that the amount of percolation of rain water decides whether certain alkaline salts derived from the weathering of rocks shall be washed downwards or not, and it is because of their effect upon percolation that these two meteorological factors are so important. As an offset to this case of underestimation of meteorological influence, Dr. Keen cites a case of overestimation, the subject being the aeration of the soil. The point that had to be explained was how it comes about that the composition of the soil atmosphere is so nearly the same as that of ordinary air, in spite of the fact that most biological activity in the soil tends to absorb oxygen and evolve carbon dioxide. A critical examination of the different processes leading to gaseous exchange between the soil and the atmosphere points to ordinary gaseous diffusion as the principal agent of exchange, meteorological processes being too slow. The rate of diffusion, moreover, is dependent upon total pore space rather than upon the size of individual pores, which would appear to dispose of the idea that 'heavy' soils—those with the smallest particles—are necessarily the most badly aerated. Another important point made in the lecture is that water is not conveyed to the surface of the ground by capillary action from nearly such great depths as had at one time been supposed, from which it follows that the good effect of a surface mulch of loose soil or other material is often unconnected with the reduction of evaporation from the surface.

The Newcomen Society

THE Newcomen Society for the study of the history of engineering and technology has just published its tenth volume of *Transactions*, containing the papers read during the year 1929–30, various notes and contributions, and a subject list of books and pamphlets relating to the history of technology, 1931–32. To mark the completion of ten years' labour, the Council has included in this volume a complete index to the whole of the *Transactions* and also an index to the various bibliographies. Both these indexes should prove of great use. As usual, the papers and notes cover a very wide field, ranging from ancient civilisations to the first steam engine in America and bell-founding; while the printing and illustrations leave little to be desired. The Society's financial position is sound, and the membership has increased slightly; more than a quarter of the members reside in the United States. Each year the Society holds a short summer meeting in the provinces, and it never fails in bringing to light the existence of historical industrial sites or directing attention to the industrial history of the district in which it meets. From time to time it has either taken the initiative or co-operated in the commemoration of the centenaries of

eminent engineers and inventors, and we understand it has already taken steps which should ensure the proper recognition of the centenary of the great Cornish engineer Richard Trevithick, who died in 1833. Trevithick died in poverty at Dartford and lies in an unknown grave, but in 1883, through the action of the Institution of Civil Engineers, a window in his memory was erected in Westminster Abbey. He was one of the most gifted inventors who ever lived, while as an engineer he was the pioneer of the high-pressure steam engine, and this at a time when the authority of Watt, who would have nothing to do with high pressures, was almost world-wide.

An Empire Museum Survey

Amongst many topics dealt with by Sir Henry Miers in his fourth presidential address to the Museums Association was that of an Empire Museum Survey. A few years ago the possibility of so great a venture would have occurred to no one; now the Survey itself is far advanced towards accomplishment, thanks to the initiative and energy of Sir Henry Miers himself. It began with the Carnegie United Kingdom Trust survey of the museums of the British Isles; it was continued with rapidity when the Carnegie Corporation of New York, in addition to all it is doing for the United States, expressed its willingness to expend certain funds allocated for expenditure within the British Empire (exclusive of the British Isles) upon such a scheme. In 1931, Sir Henry Miers and Mr. Markham visited 121 museums and galleries in Canada; early this year they visited all the museums they could discover in the Union of South Africa and in Rhodesia, as well as many others encountered on the return journey by Khartoum, Cairo, and Port Said. This year also a survey of museums in British possessions in the Mediterranean Sea was carried out by Alderman Squire and Mr. Herdman. So that in a year, from June 1931 until June 1932, two-thirds of the Empire Survey has been completed; and now there remain only to be tackled the Commonwealth of Australia, Tasmania, New Zealand, the West Indies, and a few almost inaccessible places like the Falkland Islands.

Mississippi Floods

The disastrous floods in the Mississippi basin in the spring of 1927 have led to various suggestions for preventing their recurrence. These are critically examined by M. O. Messerly in a paper entitled "Les Travaux de defénse du Mississippi" in *Matériaux pour l'etude des calamités*, No. 3, année 1931 (1932). Several of the proposals would probably lead to effective defence, but are not feasible on the score of cost. The construction of reservoirs on the tributary streams would be useful but very expensive. In industrial districts, however, such reservoirs would have a local use, in addition to their protective value. Setting back the embankments along the lower reaches, if done on a large enough scale, would help considerably, but is scarcely practicable. Dredging of the bed would be effective, but only if continuous and on a very large scale. Afforestation might help in checking the flow of rainfall to the rivers, but even vast schemes might afford only small relief. In any case, the effect would not be felt for a generation or more. The most practical measures seem to be the raising and strengthening of the embankments at certain places, the construction of new drainage channels parallel with the main stream, and the straightening of the river in places to facilitate the flow of water.

Duck Decoy Ponds in Europe

Science Service (Washington, D.C.) publishes a Berlin message concerning the slaughter of migratory ducks by decoy ponds in Europe. In Germany there are at present eleven decoys, with an average annual catch of 40,000 ducks; in Denmark two, with an average of 12,000; in Belgium four, average not stated. England is said to have twenty-one, capturing about 600 ducks; and Holland to have the greatest number of decoys, 145, having an average yearly catch of 300,000 ducks—a number until now suppressed in the interest of the Dutch canning industry, which has built up a profitable export trade upon the proceeds of the decoys. The finding of ringed birds shows that the ducks caught in Holland come largely from Scandinavia and Finland, and the fear is that the supply will eventually fail under this serious annual drainage. The open season lasts from July 27 until Feb. 14, or even March 13, and a shortening of this period would have a good effect, but it is said that the Dutch Government is unwilling to interfere with a profitable home industry. Nevertheless, an effort will be made, at the International Conference, to have the open season reduced to a period from Sept. 15 until Jan. 31.

Bibliography of Newcastle-upon-Tyne Local Records

As all interested in bibliographical matters no doubt know, Newcastle-upon-Tyne possesses an excellent public library, rich not only in the books generally found in such institutions, but also particularly in works of local interest. Having regard to the fact that Newcastle-upon-Tyne and the district of which it is the centre have taken such a prominent part in the invention and the development of technical methods and appliances of great industrial importance, it is obvious that these records of local doings necessarily appeal to a far wider public, and the librarian, Mr. Basil Anderton, has done well in publishing a "Catalogue of Local Records". The catalogue falls into two main divisions, namely, an author list and a subject list, together with certain appendixes which are perhaps of more strictly local interest. The subject list will probably be the one that will be more generally consulted, and it contains material of the greatest value, especially to the historian of matters of technological or sociological import. It need scarcely be said that in a coal-mining centre like Newcastle-upon-Tyne, maps of the coal mines and royalties of the surrounding district play an important part, and give information of the utmost value to students of the development of the coal-mining industry. The catalogue appears to be very well executed, is well printed and published, and will form a valuable and useful addition to British bibliography.

Progress of the Ordnance Survey

The Report on the Progress of the Ordnance Survey for the year ending March 31, 1932, directs attention to the steadily increasing sale of small-scale maps, particularly the one-inch scale. This is no doubt due

to their increased use by walkers and cyclists. The fourth revision of the one-inch maps is making progress in the south of England, and Sheet 144 has been published in the new style. On the other hand, the revision of the six-inch sheets has fallen into arrears, which it is hoped will shortly be overtaken. Owing to lack of adequate staff, it has become necessary to restrict revision of the 1/2500 scale plans to those sheets which are found to be very considerably out of date owing to development of the ground. By this restriction it is hoped to overtake the more important arrears of work in areas of recent urban growth. Key maps of Great Britain attached to the Report show that in the greater part of Scotland and Wales and much of England the last revision of the 1/2500 and six-inch scales was more than twenty years ago.

Manufacture of Electric Railway Equipment

THE surburban services of the Danish State Railway around Copenhagen are to be converted to electric working on the high-pressure direct current system at 1500 volts. We learn from the *English Electric Journal* for July that the contract for 42 motor coaches and 21 trailer coaches has been awarded to the English Electric Company. There are now 'English Electric' equipments operating railways in seventeen different countries of the world. The Danish State Railway is the fifty-sixth railway to be electrified with the Company's material. The first high-voltage direct current electric railway operating in the world was the Bury-Holcombe Brook route of the Lancashire and Yorkshire Railway. In 1913, the English Electric Company developed the motors and control gear used on this line, which operated on 3600 volts. Few companies have had such world-wide experience in making electric railway equipment of all kinds.

Baltic Geographical Studies

THE report of the twenty-fourth meeting of German geographers held at Danzig on May 26–28, 1931, has been published as a volume (Verhandlungen und wissenschaftliche Abhandlungen des 24 Deutschen Geographentages, Breslau), which contains, in addition to the proceedings of the conference, a number of valuable papers. These cover a wide range of topics, but perhaps the most striking is a series on Baltic geography, including a paper by Prof. G. Braun on the oscillations of level of north-western Europe and the development of the Baltic from glacial times. A tabulated chronology of changes in the area makes an interesting study. Prof. B. Schulz writes on the waters of the Baltic, and Dr. W. Quade contributes a long study on the evolution of the port of Danzig in relation to the changes in the mouths of the Vistula. This paper is illustrated by a number of old charts.

The Imperial Economic Committee

THE twenty-sixth Report of the Imperial Economic Committee consists of a review of its constitution and work, and traces the development of its terms of reference. Suggested at the Imperial Economic Conference of 1923, the Committee was brought into being in 1925 with very restricted terms of reference that dealt only with the marketing of Empire food products in Great Britain. This led to the institution of the Empire Marketing Board in 1926, the year in which the Imperial Conference widened the work of the Committee to include the consideration of raw materials of manufacture as well as foodstuffs, and also industries and trades. The Conference of 1930 laid stress on the survey of mineral resources, and entrusted the Committee with the study of various aspects of Imperial co-operation. Its numerous reports on various products and materials are of considerable scientific value.

Announcements

THE opening meeting of the eighth session of the Electroplaters' and Depositors' Technical Society will be held on Sept. 28, at Lyons' Angel Café, Islington, N.1, when a discussion will be held on "The Possibilities of Standardising Electrodeposits".

THE Institute of Transport has made the following premium awards for the session 1931–32: Institute Triennial Gold Medal to Sir Lynden Macassey; Railway (Operating) Gold Medal to H. H. Mauldin; Railway (Engineering) Gold Medal to Sir Harold Hartley; Road Transport (Passenger) Gold Medal to Horace M. Wyatt; Water Transport (Canal) Gold Medal to A. J. Pearson; and Institute Graduate Silver Medal to J. M. Powell.

ORNITHOLOGISTS will be interested in Messrs. Wheldon and Wesley's new catalogue of ornithological works, which includes 2039 items. The collection is notable for the large number of important books it contains, and readers unfamiliar with the demand for such works may be surprised to learn that the seven volumes of Lilford's "Birds of the British Isles" are priced at £32, Dresser's "History of the Birds of Europe" at £48, Gould's "Birds of Europe" at £70, and his "Birds of Asia" at £175.

THE following scholarships have been awarded by the Institution of Electrical Engineers for 1932: Ferranti scholarship to C. D. J. Statham (University of Sheffield); Duddell scholarship to P. J. Rattue (Staveley Grammar School); Silvanus Thompson scholarship to W. E. Arnold (London Midland and Scottish Railway Co.); Swan memorial scholarship to G. N. Davison (Sunderland Technical College); David Hughes scholarship to R. G. Armstrong (University College, London); Salomons scholarship to J. S. Wright (King's College, London); War Thanksgiving education and research fund (No. 1) to G. J. Scoles (University College, London) and T. H. Walker (University of Sheffield); Thorrowgood scholarship to B. O. Banks (Metropolitan Railway).

MEMBERS of the staff of the Rothamsted Experimental Station are offering to give, during the forthcoming winter, a few lectures on the experimental work of the Station, to chambers of agriculture and horticulture, farmers' clubs, farm workers' associations, agricultural societies, etc. No fee will be charged for such lectures, but the association engaging the lecturer must defray his expenses. The subjects offered include manures, soil micro-organisms, agricultural botany, agricultural chemistry, soil physics, entomology, and mycology. Further particulars can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Polarisation of Wireless Echoes

We were much interested in Mr. T. L. Eckersley's description[1] of a method of demonstrating the polarisation of wireless echoes, but surprised to find that some of the results he mentions appear both contradictory to the magneto-ionic theory and also to those obtained when other comparable methods of polarisation delineation are employed in the same connexion. Soon after Mr. Builder and one of us described the occurrence of regular echo-doublets and suggested that they were composed of the two oppositely polarised magneto-ionic components, various methods of demonstrating the correctness of this hypothesis were devised by members of the group of workers associated with the Radio Research Board. Some months ago Mr. R. A. Watson Watt and one of us, at the Radio Research Station, Slough, and Mr. E. L. C. White and the other, at the Cavendish Laboratory, Cambridge, independently and simultaneously developed apparatus for demonstrating the different polarisations of the echo-doublet components. The Cambridge apparatus is similar in principle to that of Mr. Eckersley, but is somewhat simpler to construct and to adjust.

In the apparatus used at Slough (and also at Radio Research Station, Tromsö) a radio-polarimeter is used in which the polarisation of the separate components is delineated on a cathode-ray screen. This method possesses the advantage that the complete polarisation specification, circular or elliptical, right-handed or left-handed, is shown by the oscillographic trace, and it is not necessary to assume, *a priori*, as with Mr. Eckersley's apparatus, that the components are circularly, and not elliptically, polarised. (A brief description of this apparatus, together with a statement that the echo-doublet components had been shown to be of opposite polarisation, appeared early in July last.[2])

With both these methods, and also with still another in use at King's College, London, it has been demonstrated that the components of a doublet echo are oppositely polarised in sense, the usual but not quite invariable result being that, when simple splitting is in evidence, the component of lesser delay is of right-handed sense and the component of greater delay left-handed. (We here use the same convention as Mr. Eckersley and view the polarisation looking in the direction of propagation of the waves.) Many observations on split echoes have been made using these methods at Cambridge, the Radio Research Station, Slough, and King's College, London, and a full account of them will, we hope, soon be published. The results obtained by the different methods are in close agreement, and also fit in with those of previous polarisation determinations made on longer wavelengths using the frequency-change method.

In connexion with the daytime absorption of the waves, we find ourselves in disagreement with Mr. Eckersley both as to the experimental results and as to the interpretation of the magneto-ionic theory. Experimentally we have found that, with wavelengths such as Mr. Eckersley mentions, while both components may be present, the left-handed one is more frequently that of greater intensity. The presence of both components is in agreement with the observations of Krüger and Plendl,[3] who found that at vertical incidence waves of 53 metres were returned from the ionosphere plane polarised with a rotating plane of polarisation. This would be the result of the presence of two circularly polarised components with a varying phase difference. Our deduction from the magneto-ionic theory is just the reverse of Mr. Eckersley's, for we find that the theory suggests that it is the right-handed component which suffers the greater absorption.

We cannot understand the contradiction between our results and those of Mr. Eckersley, and look forward to the publication of a full account of his theory and experiments so that we can trace exactly where the difference lies.

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Sept. 14.

[1] Nature, p. 398, Sept. 10, 1932.

[2] *Wireless World*, July 8, 1932; see also *The Wireless Engineer*, p. 513, Sept. 1932.

[3] *Z. Tech. Phys.*, 12, p. 673; 1931.

Spectrum of Cosmic Radiation

Cosmic radiation forms a whole series of lines or bands in its spectrum, as can be established by measuring its absorption coefficient. The most penetrating of its constituents, having energy of about 3700 million volts, originates, according to Sir James Jeans, in the annihilation of an α-particle and its two neutralising electrons,[1] while the next softer constituent, of energy about 950 million volts, is formed by the annihilation of one proton and its neutralising electron. In both these cases, as generally accepted, one can scarcely suggest any other interpretation. The interpretation, however, of the softer constituents by the formation of helium and higher atoms from 'metastable clusters' consisting of protons and electrons, as suggested by Prof. R. A. Millikan,[2] has supplemented the first assumption of the origin of cosmic radiation:

$$\text{Proton} + \text{Electron} = h\nu,$$

made by Sir James Jeans, which seemed unable to give more than one line and did not indicate any logical or numerical connexion between the energy value of the proton-annihilation constituent and those of softer ones.

The object of this note is to point out a curious regularity which seems to occur in the energy values of the constituents of cosmic radiation. If we divide the annihilation quantum of the proton $h\nu \cong 950$ million volts by $n(n+1)$, where $n = 0, 1, 2, 3, 4, \ldots$, we get the values tabulated below (expressed in millions) together with those observed in cosmic radiation:

n	0	1	2	3	4	5	6	7
$h\nu$ calcul.	950	475	160	80	48	32	22	17
$h\nu$ observed	~950	~450	~180	~100	?	~30	(22·5)	~15

The observed values given under $n = 5$ and $n = 7$ are the limits of the 'soft band' as established by Prof. Millikan by measuring its penetrating power in comparison with that of γ-rays of thorium C'', the value 22·5 million volts being their average.

If this is not a pure accident—and one can scarcely believe it is—it must appear very surprising that an equation of the form

$$h\nu = \frac{h\nu_{\text{annih.}}}{n(n+1)}$$

succeeds so well in reproducing the spectrum of cosmic radiation in terms of the energy value of annihilation

of the proton-electron system. For, it is the very form deduced by Schrödinger for the quantum levels of the rotator with free axis.

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[1] J. Jeans, NATURE, 128, 103, July 18, 1931.
[2] R. A. Millikan, NATURE, 128, 709, Oct. 24, 1931.

Cystine and Wool Production

IN 1928 Marston and Brailsford Robertson emphasised the importance of cystine in the biology of the sheep.[1] They considered that since a typical fodder protein such as that of lucerne contains 0·93 per cent of cystine and the keratin of wool fibre contains 13·1 per cent, cystine might well be a limiting factor in the production of wool. Three assumptions were made by them, namely, that the cystine content of pasture lies within certain limits, that cystine cannot be synthesised in the animal body, and that the cystine of wool fibre is relatively constant.

As regards the first point, Evans[2] and Aitken[3] have shown that the cystine of pasture grass is of such a small order, about 0·01 per cent, by weight, of dry matter, that, as pointed out by Rimington and Bekker,[4] the amount of cystine present in the grass consumed by a sheep cannot be made to account for the amount of cystine present in the fleece. The argument of Rimington and Bekker depends upon the correctness of the figures of cystine analysis of grass, which, as pointed out by Marston,[5] is one of extreme difficulty and complexity, and it is probable that the figures must at present be accepted with caution.

The results of a recent experiment performed in collaboration between the Rowett Institute and the Wool Industries Research Association, Leeds, which are to be published fully at a later date, throw light on the matter at a new angle. During the course of the experiment, a group of twenty sheep received 503 lb. of digestible protein. The crude weight of the wool produced during the same period was 72 lb. Allowance has to be made for grease, impurities, and moisture content. Thus:

	lb.	lb.
Crude weight of wool	..	72
Grease and impurities . . .	15·5	
Moisture content . . .	10·4	
		25·9
Estimated weight of clean dry wool ..		46·1

The weight of the clean dry wool, therefore, corresponds to 9·2 per cent of the weight of the digestible protein fed. Accepting the figure of 13 per cent as an approximate value for the cystine content of wool, the 46·1 lb. of clean dry wool would contain 6·0 lb. of cystine, corresponding to 1·19 per cent of the weight of digestible protein food. Making the generous allowance of 40 per cent of the ingested cystine retained as wool, the cystine content of the protein fed would correspond to the figure of 2·88 per cent given for blood albumin by Brailsford Robertson and Marston.[1] The proteins actually fed were those of turnips, oat straw, maize, bran, oats, and distiller's dried grains. Since the cystine content of such vegetable proteins is much lower than that of blood albumin, it is difficult to avoid the conclusion that some synthesis of cystine took place.

Finally, in a series of important papers, King, Barritt, and their colleagues at Leeds have shown quite conclusively that the cystine content of wool fibre is not constant, but that it fluctuates within fairly wide limits.

It follows that the evidence available in contradiction to the hypothesis of Marston and Brailsford Robertson suggests that the cystine content of pasture is so low that it cannot be conceived as being a possible limiting factor in wool production, that synthesis of cystine very possibly occurs in the sheep, and that the cystine content of wool fibre is not constant.

The experimental evidence cited by Marston in a recent communication[5] is unsatisfactory. An experiment by Lines is quoted in which casein was contrasted with yeast (containing 3·5 gm. cystine a day) as a source of nitrogen superimposed on a protein-deficient basal diet. The yeast gave very much better results, but the vitamin, mineral, and other factors present in yeast were apparently ignored, and were certainly not controlled.

In a field experiment in Central Queensland, blood meal (containing 2·7 per cent cystine) was fed *ad lib.* to ewes and lambs, the maximum intake of 6 oz. a head a week being reached under drought conditions. Unfortunately, the experiment was not controlled, since a cystine-poor concentrate of equal caloric value was not fed to the control group. It is therefore impossible to say how much, if any, of the beneficial effect was due to cystine or even to protein.

The bulk of the evidence is thus in favour of the synthesis of cystine within the sheep, and the question of the possible mode of synthesis arises. Rimington and Bekker suggest the decomposition of symbiotic intestinal bacteria as the source. On this hypothesis, sheep reared from birth on sterilised foodstuffs (suitably supplemented with vitamins) should grow little, if any, wool. It is therefore a hypothesis capable of critical test. The fact that wool growth is at its maximum before the lamb's rumen has fully developed is against this view.

It seems to us possible that cystine is formed during keratinisation, and that cystine synthesis is a function of the wool follicle itself. The amount of cystine produced in a fleece would then depend upon the number and activity of the wool follicles, and not upon the cystine content of the food or the bacterial population of the intestines. It appears to us that this hypothesis accords more closely with the great diversity of weight of fleece grown by different breeds under the same environmental conditions.

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[1] Marston and Brailsford Robertson, *Bull.* 39, Commonwealth of Austral. Coun. Sci. and Ind. Res., 1928.
[2] Evans, *J. Agric. Sci.*, 21, 806; 1931.
[3] Aitken, *Biochem. J.*, 24, 250; 1930.
[4] Rimington and Bekker, NATURE, 129, 687; 1932.
[5] Marston, *Austral. J. Exp. Biol. and Med. Sci.*, 9, 235; 1932.

Diffraction of X-Rays by Liquid Metals

WHEN a beam of monochromatic X-rays is passed through a liquid, the intensity of scattered radiation does not, in general, fall off uniformly with scattering angle. One or more regions of maximum intensity are usually observed, and these may appear as bands or diffuse rings on a photographic plate placed to receive the rays. These facts are well known. Nevertheless, it is probably true to say that no completely satisfying explanation of such effects has yet been produced. One of the most attractive proposals has been put forward by G. W. Stewart in a series of recent papers.[1] Stewart suggests that temporary groupings of considerable numbers of atoms or molecules in the liquid would account for the observed

diffraction effects. This view is somewhat strengthened by the observation that the maxima for the liquid state are frequently in positions very similar to those of the strongest maxima for the solid material. It therefore appears that the units in the liquid are probably trying to group themselves according to their customary positions below the melting point.

The testing of any quantitative theory of the liquid state will probably be much simplified if results on simple substances are available. With this end in view, we have recently carried out X-ray diffraction experiments on several liquid metals. So far, liquid sodium, potassium, rubidium, and cæsium have been investigated, and work on lithium, lead, zinc, cadmium, bismuth, and other elements is proceeding. Sodium, potassium, rubidium, and cæsium are of the body-centred cubic type in the solid state, and the liquids, at temperatures not very far removed from the melting point, each diffract the X-rays in one main direction, so that a single narrow band is observed. Fig. 1, showing the ring for rubidium, gives

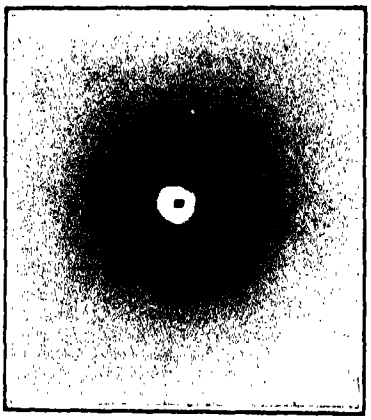

FIG. 1.—X-ray diffraction pattern for liquid rubidium. Copper $K\alpha$ radiation. Spacing of band, 4·00 A.

some idea of the rather surprising sharpness of definition obtained with all four liquids. The accompanying table gives approximate spacings of the bands. The metals were in each case distilled into exceedingly fine glass capillaries, and the melting carried out by means of an external heating coil.

Element.	Approximate Spacing in A. of Band due to Liquid.	Approximate Width of Band in Degrees at Half Intensity.	Spacing of (110) Plane for Solid in A.
Sodium .	3·01	6° 0′	3·04
Potassium	3·87	— *	3·68
Rubidium	4·09	4° 50′	3·97
Cæsium .	4·51	9° 30′	4·28

* Microphotometer records of our films for liquid potassium are not yet available.

It may be noted that in each case the spacing of the liquid band is approximately the same as the spacing of the strongest line of the corresponding solid. Work is now proceeding on the correct interpretation of these results, a full discussion of which we hope to publish elsewhere.

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H. P. ROOKSBY.

Research Laboratories,
General Electric Co., Ltd.,
Wembley, Aug. 19.

[1] See for example *Phys. Rev.*, **37**, 9; 1931.

Electrochemical Periodicities

DR. J. A. V. BUTLER and G. Armstrong[1] and Dr. E. S. Hedges[2] have published some very interesting observations on periodicities in electrolitic cells. I have made similar observations in a cell with 25 per cent sulphuric acid as electrolyte and a copper anode. The e.m.f. and resistance of the circuit being constant, under certain conditions the current through the cell assumes values from a few milliamperes to a fraction of a milliampere alternatively. The time of the alternations is variable, under different conditions, from about one to ten seconds.

This phenomenon lasts from several minutes to one hour or more, changing gradually. It is essential for the production of these oscillations that the ratio between e.m.f. and circuit resistance should have a certain value, corresponding to a critical value of the current density, approximately 43 ma./cm.^{2}

This phenomenon is caused by periodical variations of the cell resistance,[3] due to the alternative formation and destruction of a thin insulating layer on the anode. This layer is analogous to that responsible for the passivity of metallic electrodes.

M. LIGNANA.

Physical Institute,
University of Turin,
July 31.

[1] NATURE, **129**, 613, April 23, 1932.
[2] NATURE, **129**, 870, June 11, 1932.
[3] *L'elettricista*, Feb. 1932.

Thermochemistry and the Periodic Table

(ENERGY OF TRANSFER OF ELECTRONS ON OXIDATION)

SINCE the formation of chemical compounds depends on rearrangements among the electrons of the outer shells of the atoms concerned, it may well become the aim of thermochemists to connect changes of energy with the corresponding change in the arrangement of those electrons.

In my endeavours to develop the subject on these lines, I have been handicapped by scarcity of data. The energy of formation of the direct linking of oxygen to a number of elements has, however, now been obtained by C. R. Bailey[1] from the band spectra (in the infra-red) of a number of non-polar compounds examined by him at University College, London.

In the accompanying table these energies are correlated with the covalencies of the elements concerned:

Element.	Energy of Linkage with Oxygen (per gm.-atom of element). Kilo-cal.	Covalency of Element.	Column 2. / Column 3. Kilo-cal.
First Periodic Series			
Hydrogen . .	110	1	110
Second Periodic Series			
Carbon . . .	237	4	59·3
Nitrogen . .	171	3	57·0 Mean 58·6
Oxygen . .	118	2	59·0
Fluorine . .	59	1	59·0
Third Periodic Series			
Silicon . .	180 (?)	4	45·0 (?)
Phosphorus . .	148	3	49·3
Sulphur . .	101	2	50·5 Mean 49·9
Chlorine . .	50	1	50·0

In column 2 of the table, the energy of formation of the linkage H-O, as in water vapour, has been added to the series given graphically by Bailey.[1]

These energies of formation are seen to be a periodic function of the atomic number, being large for the early members of a series and decreasing steadily until

a minimum is reached for the last member of the series.

Such periodicity in a physical quantity is usual. What are not usual, however, are the regularities found in column 4. These call for special comment, and may be explained on the following lines:

(1) The covalency of the element is a measure of the number of electrons transferred from the oxygen in order to produce a stable shell.

(2) The energy of linkage divided by the covalency, therefore, represents that portion of the energy of the linkage which is directly associated with the transfer of one electron from the oxygen.

The energy per electron, estimated in this way, is seen in column 4 to have approximately the same value, 59 kcal., for the linkage of oxygen with each of the several atoms of the second series of the periodic table, that is, with atoms consisting of a nucleus and one shell of electrons. Lower values are obtained for linkages with atoms of the third series of the periodic table, that is, atoms consisting of a nucleus and two shells of electrons. The values approximate to 50 kcal. except in the case of silicon.

The value is 110 kcal. for the linkage with hydrogen, the sole member of the first series of the periodic table.

From these facts, it may be deduced that:

(1) The energy of formation of the linkage of an element with oxygen is proportional to the covalency of the atom of that element, depends on the number of electron shells in that atom, and is not affected directly by the nature of the nucleus; (2) the 'energy of transfer' of an electron on oxidation is approximately the same for all atoms with the same number of electron shells, and is smaller the greater the number of shells.

More data are needed before other linkages can be tested on these lines. T. C. SUTTON.

Research Department,
Royal Arsenal, Woolwich,
Aug. 22.

[1] C. R. Bailey, NATURE, 130, 239, Aug. 13, 1932.

Observations on Filmed and Filtered Vowels

PROF. E. W. SCRIPTURE [1] has put forward a theory of the construction of vowel sounds, from which he concludes that " a vowel profile is a course of air vibration, muscular movement, nerve currents, and inner (psychic) activity ". In support of this he says: " [the vocal cavity] does not consist of a set of cavities connected by orifices but of one cavity of complicated form that cannot be analysed into separate cavities. . . . The shape of the vocal cavity is never constant for even the briefest instant; it is constantly and continuously changing according to the muscular movements that regulate it." These suppositions require some amendment.

Until Sir Richard Paget made the first artificial vowel models in plasticine,[2] there was admittedly some doubt as to the action of the vocal cavity, but the experimental fact that a true vowel sound may be excited in a rigid cavity disposes of the view that the muscular flexibility of the mouth has any serious influence on the form of the complex sound produced. Nor is it true that the vocal cavity is a single one of complicated form. In all vowels two dominant inharmonic resonances can be detected,[3] arising from the division of the mouth by the tongue into two distinct cavities. In the 'front' vowels (as in 'eat, it, hay, men, hat') it would appear that 'resonant' vibration takes place in the larger rear cavity, and stationary vibration in the smaller front passage,[4] an arrangement similar to the modes of vibration of air in a flask with a long neck of narrow oval section. (This result was actually foreseen by Helmholtz.) The modes of vibration are then determined by the equation

$$\tan mh \,.\, \tan mk = \frac{a}{A},$$

when the 'neck' is of length h and area a, and the rear cavity of length k and area A. In this instance, experiment has shown good agreement with this modification of the general theory of the double resonator.[5] The nature of the 'middle' and 'back' vowels is clear by experiment, but cannot at present be verified by theory owing to the great difficulty of bridging the gap between 'resonant' and 'stationary' vibration. The gap, of course, only exists in our range of mathematical tools.

The subject of compound resonance has been much confused in recent years by the use of mechanical and electrical analogies, many of which are misleading and some definitely at fault.[6] Branches of acoustics to which the electrical analogy has been successfully applied, such for example as the 'fingering' of the flute, can usually be treated quite as easily, and always with more understanding, by the application of classical theory, and particularly by the use of those methods, now neglected, so beautifully presented by Lord Rayleigh.

Sir Richard Paget's work leads to the conclusion [7] that " the ear judges a vowel by the form of the compound wave. The ratio of the amplitudes is possibly quite as important as the ratio of frequencies, and a resonator is only successful in imitating a vowel when both ratios can be reproduced." This is in agreement with Prof. Scripture's hypothesis that " the vowel character depends on the general shape of the vibration profile ". W. E. BENTON.

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Deepfields, Staffs.

[1] NATURE, 130, p. 275; Aug. 20, 1932.
[2] *Proc. Roy. Soc.*, A, 102, p. 752, *et seq.*
[3] Paget, " Human Speech ", Kegan Paul, 1930, p. 42.
[4] *Ibid.*, p. 292.
[5] *Ibid.*, p. 297.
[6] Compare Paget's " Human Speech ", pp. 285-288, with Dr. F. G. Richardson's " Sound ", pp. 55-57. Also *Proc. Roy. Soc.*, 101, 391; 1922.
[7] Paget, " Human Speech ", p. 298.

Isotopes of Uranium

WE have succeeded in finding evidence of several isotopes of uranium which emit alpha-rays. In the expectation that the proportion of actino-uranium would be larger the younger the mineral, uranium from Colorado carnotite was used, the age of which has been variously estimated at from 170,000 to 7,000,000 years. The half-periods estimated by Wilkins [1] and by Rutherford [2] for actino-uranium, from quite different methods of reasoning, were 2·5 and $4 \cdot 2 \times 10^8$ years respectively. The corresponding alpha-ray range would be about 3·2 cm.

In the present work, the alpha-rays from a very thin sputtered film of uranium fell at various angles on a special, fine-grained photographic emulsion 30μ thick, the grain distribution of which was shown to be independent of depth. The number of grains in the track of an alpha-ray in the emulsion was counted. A typical frequency curve for polonium is shown in Fig. 1, *A*, and for uranium in Fig. 1, *B*. The peak for the polonium rays is at 13 grains. The peaks in the uranium curve at 9 and 11 grains are taken as due to U I and U II. These three ranges agree with Laurence's values of the relative ranges of U I, U II, and Po. The analysis of the curve has not been completed but other alpha-rays of a subsidiary series with distribution peaks at 11, 13, and 16 grains seem indicated.

A peak at 11 grains might very well be due to actino-uranium. Those at 13 and 16 grains would indicate isotopes the ranges of which are remarkably close to proto- and radio-actinium.

The analysis of the curve is complicated not only by the fact that the relative abundance of the alpha-rays of the two series is unknown, but also that the shape of the frequency curve of a given member changes with the range. Data have, however, been secured on this latter point. A study of the former using uranium from various geological horizons is expected to give an attractive method for determining the ages of rocks which appears to be free from errors inherent in the method based on U/Pb ratios. For the very recent uranium used in this work, the uranium and actinium isotopes seem to be about equally active.

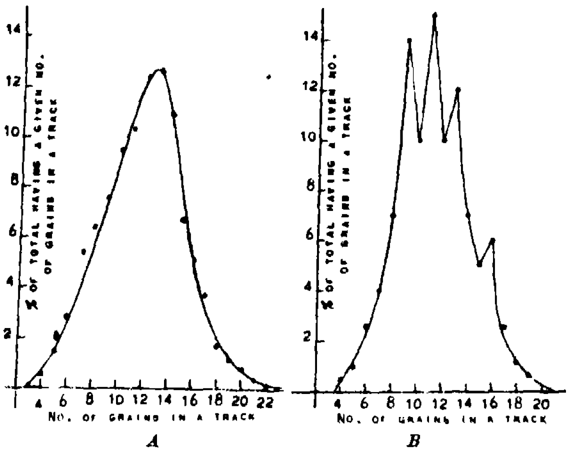

FIG. 1.—Typical alpha-ray frequency curves. *A*—Polonium. Polonium source above special laboratory lantern, emulsion 30μ thick. Data on 1038 tracks. *B*—Uranium. Sputtered uranium source above a special laboratory lantern, emulsion 30μ thick. Data on 2367 tracks. I—436, II—441, III—454, IV—544, V—492.

T. R. WILKINS.
W. M. RAYTON.

University of Rochester,
Rochester, N.Y., July 3.

[1] NATURE, 117, 719; 1926.
[2] NATURE, 123, 313; 1929.

The Influence of Asia

JUST recently there has loomed in the mist of the past some wider conception of historical beginnings. By stating these we may awake attention to any further detail that may clear the view; the ideas may be modified when we come to close quarters.

A wide movement seems to take place periodically from the Caspian region to Syria and Egypt. Saladin the Kurd with his Turkoman troops conquered Syria and Egypt by A.D. 1170. About 950 B.C., models of box wagons and wheels, like those of Anau and Assyria, are found in Palestine, brought by Eastern migrants, who were probably the followers of Sheshenq (named from the Persian deity "He of Susa"), who conquered Egypt 940 B.C. By 2370 B.C. the Hyksos swept into Egypt, using the horse, and the toggle pin for dress fastening, usual in the Caspian region. At 3100 B.C. a skilful race of builders, using the toggle pin, and daggers with raised ribbing, both belonging to the Caspian basin, conquered Palestine and Egypt, as the Seventh Dynasty. An Asiatic movement about 5500 B.C. brought lazuli and the use of the face-veil into Egypt. Long before that, the names of the principal sites of the Caucasus were embedded in the Osiris mythology of the Egyptians, brought with emmer wheat from that region by the Badarians, who were certainly Asiatic. Each of these invasions helps our understanding of the others.

Another serial connexion begins with the celebrated ivory carving of Gebel el Araq (4800 B.C.?), bearing figures of animals that are unsurpassed for truth and grace; it belongs certainly to Elamite art, and exhibits the conquest of Egypt by the dynastic race coming from the Persian Gulf. Three or four centuries later there was a school of fine ivory carving—as the old king from Abydos—and after a similar interval the finest minute portrait carving of Khufu in ivory. It seems impossible to suppose a race re-inventing such skill disconnectedly; it is an obvious series. That compels us to assign the highest Egyptian sculpture of the pyramid age to a Persian origin.

The group of a deity restraining lions, on the same ivory of Gebel el Araq, is the first known example of a long train of such emblematic groups, where a god or goddess subdues horses, bulls, swans, wolves, or snakes, as a symbol of power over Nature, a symbol which pervaded Persia, Mesopotamia, early Greece, and Italy. Again western Persia has been the starting point. All of this indicates the link of civilisation between the Indus and Tigris which has been demanded by recent discoveries. The dates stated above are those given by the Egyptians.

FLINDERS PETRIE.

Selection and Growth in Shore-Crabs

PROF. J. B. S. HALDANE in his new book entitled "The Causes of Evolution", p. 89, quotes the late Prof. Weldon as his authority for the statement that when the breakwater was built across the mouth of Plymouth Harbour, "the water inside became muddier, and the shore-crabs developed roomier gill-chambers". This is a complete mistake—in fact, a double mistake. Prof. Weldon did not assert that the branchial cavities of the shore-crabs had become larger, and what he did assert was shown by myself at the time to be incorrect. The subject is discussed in detail in my "Modern Biology" (1928), pp. 189-199.

The conclusion actually drawn by Prof. Weldon was that the increase of sediment in the water had, by selection, caused a decrease in the relative frontal breadth, which involved a better filtration of the water entering the branchial chambers. One point of my criticism was that efficiency of filtration could not be dependent upon a *relative* size of aperture, but must be proportional to the absolute size of aperture. The efficiency of a sieve is proportional to the size of the meshes, not to the total diameter of the sieve. Prof. Weldon's figures show that while the relative frontal breadth in thousandths of the carapace length was decreasing with increase in that length (that is, with the growth of the crab), and also in 1895 and 1898 as compared with 1893, the absolute frontal breadth increased in each year from 8 mm. to 11 mm. as the carapace length increased from 10 to 15 mm., and showed no decrease at all in one year as compared with another.

What Prof. Weldon actually investigated, therefore, was not a case of selection but a case of differential growth. The change of shape in the growing crab was known vaguely before; Prof. Weldon investigated it quantitatively in minute detail. But he did not show that the filtration of the water entering the branchial chambers depended on the relative frontal breadth, and he did not state that there was any relation between increased sediment and enlarged branchial chambers.

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London, W.4, Sept. 10.

Research Items

Indians of Matto Grosso, Brazil.—Ethnographical and archæological results of an expedition through Matto Grosso, Brazil, to the head waters of the Xingu River in 1931 are described by Mr. V. Petrullo in the *Museum Journal* (Philadelphia), vol. 23, pt. 2. A number of tribes were visited, of which one, the Tsuva, had not previously been recorded, while three, the Kalapalu, the Kuikutl, and the Naravute, had not been described. At the head waters of the Xingu, although three widely distributed linguistic stocks are represented and they are surrounded by a fourth, no appreciable difference of material culture is to be observed. The villages are composed of a few houses around a clearing. The men's house is of inferior construction, and although it is the men's meeting place, it is not used for sleeping. It serves for ceremonial uses and for the entertainment of guests only, while the men of the village sleep in their own family dwellings. Usually several families live in one dwelling; and a young man on marriage lives in the house of the bride's father until he is in a position to build a house for himself. Women are the authoritative persons of the village. Inheritance and descent proceed through them; and although the men deal with strangers, the women must be consulted and their concurrence obtained before any arrangement may be concluded. Marriage is monogamous, but only as a matter of practical and economic convenience. Headmen sometimes have two wives. Most of the groups cultivate nothing but manioc, though some have maize. The Yawalapiti keep maize effigies suspended from the rafters of their huts. These are made of an ear of maize embellished with legs, arms, a skirt, and a painted visage. Some images are in the form of birds. In one village a harpy eagle was kept in a conical structure, and every man had to share with it the proceeds of his hunting or fishing, receiving in return a feather when its plumage was ceremonially plucked.

Inherited Differences in Taste Reactions.—It has recently been shown that individuals differ in their capacity for tasting certain substances, and that these differences are inherited. The results of an experiment with phenyl-thio-carbamide, made at the New Orleans meeting of the American Association for Advancement of Science last December, are recently published by Dr. A. F. Blakeslee and Dr. A. L. Fox (*J. Heredity*, vol. 23, No. 3). Of 2550 persons tested, 65·5 per cent tasted the substance as bitter, 28 per cent found it tasteless, while 2·3 per cent found it sour, and 4·2 per cent reported another taste. Earlier tests of families had shown that the failure to taste it is inherited as a simple Mendelian recessive. When both parents are non-tasters, all the children are the same. This is found to be the case in 39 children from such parents. Individuals also differ in the threshold of stimulation, some being able to detect the taste in a few drops of a 1/500,000 solution, while some non-tasters require a hot saturated solution to perceive any taste at all. This substance, which is bitter to most people, differs from dalcin, which is three hundred times sweeter than sugar, in that an atom of oxygen is replaced by sulphur. The related *p*-ethoxy-phenyl-thio-carbamide is identical in taste, but apparently gives a slightly weaker reaction. Similarly fumar-proto-cetraric acid, a bitter constituent of certain lichens, distinguishing them from closely related species, is tasteless to some, while others find it bitter in varying degrees. The odours of certain verbenas and freesias are also found to produce various sense reactions in different individuals, some finding particular varieties odourless. By tests of this kind, inherited differences in our sense organs are coming to light (see also NATURE, **129**, 735, May 14, 1932).

Pig-feeding Experiments.—The first Pig-feeding Report of the Harper Adams Agricultural College summarises the experiments in pig-feeding carried out between 1926 and 1931. Briefly, these showed that a ration of cereal meals was deficient in proteins and certain minerals for the needs of a rapidly growing pig, but that extracted soya meal, supplemented by lime and salt, gave as good results as fish meal when added to a cereal ration. An average proportion of about eight per cent of soya meal was found to be adequate, this being best secured by using about twelve per cent in the ration for a newly weaned pig, and gradually reducing this to a minimum of 5 per cent at bacon weights. A mineral allowance of $1\frac{1}{2}$ lb. limestone and $\frac{1}{2}$ lb. salt per 100 lb. mixed meals was sufficient, and this seemed to be as effective as the more complex and expensive mixtures containing a great variety of minerals. For sty-fed pigs under normal conditions, about 3 lb. of water per 0·1 lb. meal were needed for young pigs, but this amount could be reduced to $1\frac{3}{4}$ lb. at bacon weights—a little more being allowed in hot weather. Many factors affect the economic value of milk in pig-feeding, and although whole milk gave a higher rate of gain than separated milk, yet the financial returns were lower than those obtainable by feeding separated milk, in conjunction with butter-making or cream-selling.

A Fresh-water Medusa from China.—T. Fujiwara (*J. Science*, Hiroshima Univ., Ser. B, Div. 1, vol. 1, 1932) collected, in August 1930, specimens of a fresh-water medusa from a pool about fifty miles south-south-west of Shanghai. They were all males and were present in large numbers, but the hydroid stage was not found. The author considers that the sex of the medusæ is not dependent, as has been suggested, on the temperature of the water but on that of the hydroid stocks. He reviews the records of fresh-water medusæ in eastern Asia and gives an account of the principal characters of his specimens, dealing in some detail with the statocyst, and he states that the ring-nerve is single. He does not actually state the species of his medusa, but remarks that it agrees in a good many points with *Craspedacusta sowerbyi*, var. *kawaii* (Oka, 1907), which he considers should be separated as a species *C. kawaii* from *C. sowerbyi*.

Chromosome Cycles and Sexuality in Sporozoa.—In a memoir (*Mém. Soc. de Phys. et d' Hist. Nat., Genève*, vol. 41, fasc. I. 1-223, 150 text-figures, 1931) on the Sporozoa with special reference to their chromosome cycles and their sexuality, André Naville gives an account of the present knowledge on the life-cycles and cytology of the Neosporidia and the Telosporidia. In a discussion on the fundamental distinctions between the Protista and the Metazoa, he expresses the view that this appears to consist in the absence in the Protista of autonomous somatic elements, but he points out that in the Myxosporidia and the Actinomyxidia there are non-generative cells which may be regarded as somatic. There are no corresponding cells in the Telosporidia, a difference which confirms the prevalent view that these two groups are distinct. In the last part of the work the author states his views, rather as a working hypothesis than as a real theory, on sexual polarity, not only in the Sporozoa but also in other animals and in plants. As an example of this polarity in the Sporozoa may be

cited the Adeleida, in which the polarised gametoblast produces a number of gametocytes at each of its two extremities—one group male and the other female. In the Metazoa, among the examples considered are *Hydra*, *Ctenophora*, and *Sagitta*. The author adds a glossary of special terms and three synoptic tables in which the life-cycles and the conditions as to haploidy and diploidy, so far as they are known, are summarised for the Neosporidia, the Gregarinida, and the Coccidiomorpha respectively.

Tetraploid Tomato Plants.—Tetraploid plants of the common tomato, *Lycopersicum esculentum*, have been produced by several workers by decapitating the stem of a diploid. Some of the shoots which grow out from the callus are found to be tetraploid. Such plants show a variable amount of association of their chromosomes in fours and a certain amount of sterility. This was greatest in a tetraploid produced from a doubled haploid, and its fruits were smaller than in the diploid. Prof. E. W. Lindstrom, continuing this method (*J. Heredity*, vol. 23, No. 3), has recently produced a tetraploid from the currant type tomato, *L. pimpinellifolium*. This species and *L. esculentum* have the same chromosome number ($n=12$) and cross readily, although the hybrids show gametic sterility in F_1 and F_2. The tetraploid from *L. pimpinellifolium* is not only larger than the diploid in all parts, such as seeds, cotyledons, leaves, and fruits, but also it is highly self-fertile, although completely sterile in crosses with the diploid of either species. From it have been derived 248 mature plants in four generations. These segregated for red *v.* yellow fruits in the ratio 20 : 1, which suggests that random assortment of the eight chromotids may be taking place in meiosis. The origin of the yellow factor is uncertain, but may possibly have been from *esculentum*, as three later tetraploids of *L. pimpinellifolium* had somewhat smaller fruits than the first.

Oscillation of the Earth's Atmosphere.—In a recent memoir of the Royal Meteorological Society (No. 35, vol. 4), G. I. Taylor examines a suggestion that has been made to explain a discrepancy observed between the velocity of a free gravity wave in the earth's atmosphere given by tidal theory, namely 910 feet per second, and the values found by direct calculation and by observations of the air wave caused by the Krakatoa volcanic eruption or explosion of 1883, which come to about 1050 feet per second. The suggestion is that the discrepancy might be explained by supposing that rapid pressure changes take place adiabatically while those like the semi-diurnal pressure wave of the atmosphere are more nearly isothermal; it has been put forward by Prof. Taylor and by three other writers—Chapman, Pramanik, and Topping—who have discussed the theory of the oscillations of the earth's atmosphere in relation to observational evidence. Taylor shows that the above mentioned supposition is untenable because the transference of heat by radiation and conduction required to introduce an important difference in the speed of the wave from that consistent with adiabatic pressure changes must lead to so much damping that the amplification by resonance, required to give the observed semi-diurnal variation, even if the free period of oscillation were taken to be 12 hours instead of the customary period of 11 hours 56 minutes, becomes impossible. He finds, further, that the required resonance can only be arrived at if the time taken for an inequality of temperature to be reduced in the ratio e to 1 is greater than 76 hours. The upshot of this investigation is that the cause of the discrepancy between the theoretical value of the free period and the value 12 hours remains at the moment unidentified.

Composite Dyke of Breven, Sweden.—A detailed and stimulating investigation of the great Breven dyke has been published by T. Krokström (*Bull. Geol. Inst., Upsala*, 1932, pp. 243-330). The dyke has a length of 30 km., and ranges in width from 0·3 km. to 1·2 km. It is concluded from the results of geological, petrological, and chemical work that the exposures of the Breven dyke now visible represent a section of intermediate depth through a fissure that originally served as a channel for a series of extrusions all belonging to the same volcanic cycle. The material brought up by the successive eruptions probably emanated from a common magma reservoir, the different types of magma being along the normal line of differentiation within the reservoir (possibly accompanied by assimilation of the granite roof or walls). In chronological order the magmas corresponded to (*a*) olivine-dolerite; (*b*) olivine-free dolerite; (*c*) granophyre; (*d*) olivine-dolerite. During its ascent the granophyre altered the dolerite (*b*) by pneumatolytic action into an amphibole-rich, biotite-bearing intermediate type for which the name epidolerite is suggested. The latest olivine-dolerite is a restricted extrusion which took place after an epoch of denudation that uncovered the more deep-seated types of the dyke.

Intensities of Nebular Lines.—Bowen's conclusion that the characteristic spectra of nebulæ and certain novæ arise from improbable, but not completely forbidden, transitions in some light atoms and ions receives additional confirmation and some amplification from a theoretical investigation of the transitions by A. F. Stevenson (*Proc. Roy. Soc.*, August), in which their probability is calculated by approximate quantum mechanical methods. This is of particular interest as leading to an estimate of the density of the gas in the nebulæ, on the assumption that it must be sufficiently small to make the time between the collisions of atoms or ions at least the mean theoretical time for the lives of the initial atomic states involved in the radiation. The numbers so obtained seem reasonable, the required time being at least about twenty-six seconds in regions where the so-called nebulium lines are emitted, and at least about three minutes where the red lines $\lambda 6583 \cdot 6$ and $\lambda 6548 \cdot 1$ originate, but it has to be remembered that one important 'forbidden' line, the celebrated $\lambda 5577$ of the aurora, can be readily produced in the laboratory at pressures of the comparatively high order of a thousandth of an atmosphere.

Diurnal Variations in Cosmic Radiation.—Prof. A. H. Compton and a number of collaborators have given an account in the second July number of the *Physical Review* of the results obtained in measurements made on cosmic rays hourly for ten consecutive days, at an altitude of 3900 metres. The rays were recorded by the ionisation produced in a steel sphere of 10 cm. internal diameter, filled with air at 30 atmospheres pressure. The measurements were made relative to the effect of a radium source, a procedure which automatically eliminated a number of errors, and were finally averaged over the ten days and corrected for some pressure and temperature effects. It then appeared that the ionisation was $1 \cdot 5 \pm 0 \cdot 25$ per cent more between 8 A.M. and 4 P.M. than between 8 P.M. and 4 A.M., a result considered in satisfactory agreement with the results of other observers, if the variation is due to a soft component of the rays. It is suggested as a consequence that the inference previously made by Millikan and Cameron that the energy in the universe in the form of cosmic rays is comparable with that in the form of light is of doubtful validity.

Velocity of Light in a Magnetic Field.—It has been established with considerable accuracy by C. C. Farr and C. J. Banwell (*Proc. Roy. Soc.*, August) that the velocity of light in a vacuum of approximately one hundredth of a millimetre of mercury is unaffected by a transverse magnetic field. The optical system employed was a Jamin interferometer, in which the light paths were in fields of different strengths, one very small and the other of the order of 20,000 gauss. The whole apparatus was set up so as to minimise spurious shifts of the fringes, the position of which was watched by a number of observers as the field was established and switched off. The sensitivity of the apparatus was such that a relative change in speed of 1 part in 2×10^7 could have been apparent. By working with polarised light it was further shown that it was immaterial whether the direction of vibration lay in or at right angles to the applied magnetic field.

Diamagnetism of Bismuth.—Bismuth, which has always been of interest from its generally anomalous physical properties, has been the subject of much study recently in the form of single crystals. Goetz has confirmed in this way very strikingly the presence of an intermediate structure between the atomic lattice and the macroscopic crystals, giving for the average size of the discontinuities with which it is associated a few thousandths of a millimetre. In the April number of the *Indian Journal of Physics* it is pointed out by S. M. Rao that the existence of these sub-units of structure is in accord with the magnetic properties of the substance. Bismuth is diamagnetic, but the susceptibility depends upon the size of the particles used. Colloidal bismuth, when melted and recrystallised, shows an increase of up to thirty per cent in susceptibility, the change persisting even when allowance is made for contamination with oxide. The change of susceptibility with particle diameter is small for particles greater than about 1μ in diameter, but below this size falls off rapidly to the lower values, and for the smallest particles considered is still decreasing. The change in susceptibility thus occurs from about the particle size associated from other experiments with the mosaic structure, and affords confirmatory evidence for the reality of this.

Astronomical Topics

The Lunar Eclipse of Sept. 14.—This was the first lunar eclipse of considerable size that was observable in London under clear skies for a good many years. Lunar eclipses are of interest from the fact that they give a good idea of the general state of the earth's atmosphere, or at least of the portions of it over the regions where the moon is on the horizon. The amount of illumination within the shadow varies to a notable extent. In 1884 the moon could be seen only with great difficulty, while in 1895 the maria and other surface markings could be observed with ease. The late eclipse did not attain either of these extremes, but was perhaps somewhat darker than the average eclipse. The limb was discernible in the telescope without difficulty at all the stages of the eclipse, also the crater Aristarchus, which is the brightest point of the disc. The outlines of the maria, however, were not easily seen until the maximum phase was nearly reached; this is an effect of the darkening sky; when there is bright sky light over the eclipsed region, contrasts are more difficult to detect.

The part of the disc that was nearest the centre of the shadow was coppery in tint, but the parts nearer the edge of the shadow tended rather to bluish grey. There was a specially bright region at the north-east limb of the moon. As the moon traversed the northern portion of the earth's shadow, there was not much opportunity to test whether the air in the southern hemisphere was rendered opaque by dust from the recent eruptions in the Andes. The southern region of the moon was carefully watched; it did not appear that there was any greater darkening there than that to be expected from deeper immersion in the shadow. The next total eclipse at which the moon will be high, in Great Britain, is on Nov. 7, 1938.

Capture of Comets by Planets.—The theory that all the comets of short period have had their orbits changed from parabolas to ellipses by near approaches to the great planets has been subjected to adverse criticism lately; in particular, Mr. S. Vsessviatsky, in the *Observatory* for May last, indicated many points in which the theory gave results that did not accord with observed facts. M. Jean Bosler contributed another paper on the subject to the *Journal des Observateurs* for January last. It examines what proportion of the comets that make close approaches to Jupiter would have their orbits transformed into ellipses and hyperbolas respectively. He finds that the ratio between the two is nearly one of equality, but with a slight preponderance for hyperbolas. This is clearly a further argument, though not a very strong one, against the theory; for it had already been shown that even if all the close approaches had led to elliptical orbits, there would not be enough to maintain the supply of short-period comets; reduction of the number of ellipses by more than half would render the insufficiency still more marked.

It is not, of course, denied that such approaches may at times take place; but merely that they are insufficient to explain the large family of short-period comets. In fact, a case seems to have taken place recently; Ryves's comet, that was under observation a year ago, was shown to have approached Jupiter within a few million miles about a year earlier. A definitive orbit of Ryves's comet has not yet been computed; but those that are to hand make it somewhat probable that the orbit, after passing Jupiter, was hyperbolic.

A New Stellar Photometer.—Dr. W. H. Steavenson describes, in *Monthly Notices, R.A.S.*, for June, a simple form of photometer which has lately been inserted in his reflector. A plate of glass about a tenth of an inch thick is placed in the focal plane. Some small dents in its surface were made with a diamond, and illuminated by an electric bulb placed at the side of the tube, in the plane of the glass. The remaining light of the bulb is totally reflected in the plate, and does not reach the eye. The illuminated dents have a stellar appearance; their brightness can be adjusted by a rheostat to approximate equality with the star to be measured; the remaining difference is measured by a sliding wedge. The wedge projects beyond the eyepiece; its position for equality of light is recorded by marking on a card the distance of the end of the wedge from the tube, so that no artificial light is needed during the comparison. Ultimately the artificial star is compared with a known star in the north polar sequence. The different dents in the glass plate appear of different brightness, so that one can be selected near the magnitude of the object to be measured. Dr. Steavenson's extensive work on old novæ, etc., is well known. The new photometer should render the comparisons still more accurate.

The Value of Tuberculin Tests*

THE name 'tuberculin' has been applied to any extract, suspension, or other preparation of *B. tuberculosis* or of media on which it has grown. The Therapeutic Substances Regulations 1931 (Statutory Rules and Orders, No. 633) define the term in a more limited sense as preparations of fluid media on which the organism has been grown in artificial culture, which have been freed by filtration from the bacilli. When the filtrate has been concentrated it is known as 'old tuberculin'; its potency is measured by comparison with that of the standard preparation.

Although tuberculin is now scheduled under the Therapeutic Substances Regulations, the hopes originally raised that it would prove of value as a curative and diagnostic agent in tuberculous disease in man have not been completely satisfied. The diagnostic aspect of the problem has recently been investigated by P. D'Arcy Hart, who concludes that tuberculin tests are of definite value in certain circumstances, provided that the correct technique is observed. The Report is based on the examination of 1030 clinically tuberculous patients of all ages and types of infection, and 751 clinically non-tuberculous patients of all ages.

The intracutaneous or Mantoux test is recommended, since it is more sensitive than the cutaneous or von Pirquet test. The initial dose is 0·1 c.c. of a 1 in 10,000 dilution (in 0·5 per cent phenol-saline) injected into the skin of the forearm or upper arm. The result should be read at 48 hr. and 96 hr. A positive reaction consists of an area of erythema or erythematous infiltration the greatest diameter of which equals or exceeds 5 mm., or which is definitely greater than the reaction given by a control injection of the medium from which the tuberculin was prepared. If the test is negative, a retest should be carried out with a 1 in 1000 dilution; if this gives a negative response, a 1 in 100 dilution should be tried. A 1 in 10 dilution may be finally employed in confirmation. A positive reaction indicates hypersensitiveness of the tissues to a product, probably protein in nature, of the tubercle bacillus, and is probably only seen after tuberculous infection accompanied by the formation of histological tubercles has taken place. There is a significant interval between primary infection and the appearance of tuberculin skin reactivity. A positive response indicates merely that infection has occurred at some time in the individual's life, and not, on present evidence, that it is still active.

The positive reaction has its chief clinical value in infancy, when tuberculous infection is more likely than at other ages to be associated with, or to progress into, active tuberculous disease. The prognosis is worse the younger the patient and the more unfavourable the home conditions. An infant of less than two years, but without symptoms, should be kept under observation for several years. If obscure and persistent symptoms are present, the possibility of tuberculous infection as cause should be seriously considered. Between two and five years a positive reaction with persistent symptoms should suggest that the latter are tuberculous in origin: at more than five years of age this is much less likely to be the case. Quantitative tests, however, are of very doubtful value for estimating the prognosis in clinical tuberculosis.

A negative tuberculin reaction almost excludes the presence of tuberculous infection: with the 1 in 1000 dilution the average error in the author's series of cases was less than four per cent. With the 1 in 10 dilution, a negative reaction excludes clinical tuberculosis with an average error of a little more than two per cent (4 per cent in children up to five years of age, and 3·5 per cent in advanced cases of tuberculosis with marked toxæmia). The error is considerably greater with the 1 in 10,000 dilution, being 12 per cent. The usefulness of the test for the negative diagnosis of clinical tuberculosis depends also upon the chance of the patient giving a negative reaction should his condition, suspected of being tuberculous, be in reality due to some other cause. This chance is determined by the percentage of negative reactors among clinically non-tuberculous individuals of the same age and social status, and living in a similar environment. In Great Britain, the test can only be profitably applied for negative diagnosis, in patients of the hospital class in large cities, in childhood: in country and private practice it may also be of value in adults. The incidence of positive reactions in adults of the poorer classes in towns is too high to make a negative response of value.

Children from tuberculous households give a much larger percentage of positive reactions than those whose homes are free from this disease, and the percentage is greater when the tuberculosis is active or open than when it is closed or healed. Again, the incidence of positive reactions among children is greater when they live in contact with a tuberculous relative than when a tuberculous relative visits them only occasionally. The presence in the household of a sufferer from non-pulmonary tuberculosis does not increase the incidence of positive tuberculin reactions among the children. Infants separated from their tuberculous parents before infection has occurred and placed in healthy families appear to be no more liable to acquire infection in early life than the infants of non-tuberculous parents. All these facts suggest that the children of tuberculous families are more likely to acquire the disease than those from the non-tuberculous simply because they are more exposed to infection; in other words, no evidence of a hereditary predisposition to infection has been found by the author. Such a view is, however, not inconsistent with a conception of heredity as a determinant of the subsequent course of infection once this has taken place.

The practical conclusion from these results is that children should be kept out of contact with cases of pulmonary tuberculosis during the early years of their life, or that the chances of infection should be minimised by the careful hygienic control of the patient, such as that developed at the Papworth Settlement by Varrier-Jones. When it is considered advisable to separate the children, tuberculin tests will have an important rôle in determining which are the most suitable for this procedure.

The incidence of positive tuberculin reactions in a healthy community is an index of the risk of exposure which is determined by the frequency of open tuberculosis, the measures taken to combat it, the general hygienic standard of the population, and the infectivity of the milk supply. Unless tuberculosis can be stamped out and the population kept free from it, the development of a positive reaction in an otherwise healthy person is a favourable sign, since it indicates a degree of protection against the development of clinical tuberculosis. Natural tuberculous infection has a greater fatality in infancy than at other ages, so that it is advisable to postpone the first infection, if possible, to middle or later childhood, for example, by removal from contagion at home and by pasteurisation

* Medical Research Council. Special Report Series, No. 164: The Value of Tuberculin Tests in Man; with Special Reference to the Intracutaneous Test. By P. D'Arcy Hart. (London: H.M. Stationery Office, 1932.) 2s. net.

of the milk supply. It is, however, advantageous for the first infection to take place before adult life is reached, because of the partial immunity which may result. The evidence obtained from tuberculin tests in London school children suggests in fact that tuberculisation occurs chiefly in later childhood and adolescence, that is, when the principal activities of the individual are away from home.

It is hoped that further work will result in an answer to the question as to whether tuberculin sensitisation is decreasing in the population, following the improvement in general hygiene and control of tuberculosis. It is also to be hoped that an altogether satisfactory method of prophylactic immunisation will have been developed before the incidence of infection has fallen so much that the general population finds itself in the precarious unprotected state of a non-tuberculised race.

Winds and Weather on the Coasts of India

MR. S. BASU, of the Marine Section of the India Meteorological Department, Poona, has prepared a useful handbook on the winds and weather off the Indian coasts.* It is based, presumably, largely upon the logs of steamers of the merchant service voyaging in Indian waters, as well as on the work of meteorologists—notably Sir John Eliot—who have made a special study of the cyclones of this region, and is intended to be of service to Indian seamen. Assuming that the standard of accuracy to be expected of a professional meteorologist with extensive sources of trustworthy information has been maintained, this book should fulfil admirably the purpose for which it was written.

The most dangerous weather phenomenon with which the Indian seaman has to concern himself is of course the tropical cyclone. Tropical cyclones do not exhibit quite the infinite diversity of character shown by the cyclonic depressions of the North Atlantic, for they are definite vortices conforming to a fairly definite type. It is possible, therefore, to frame certain general principles that should be followed by a seaman who wishes to avoid exposing the vessel in his charge to the full fury of the inner circle of winds that so often attain to the full force of a hurricane. A special chapter is devoted to this problem, and contains hints as to how the exchange of weather information by radio between ships, together with the utilisation of the official weather reports issued by radio, can help in the navigational problem that arises when a ship approaches sufficiently near to a cyclone.

Another source of danger is the 'Nor'wester', a thunder-squall of early summer that is believed to have given rise to winds of more than a hundred miles an hour. It is primarily a land phenomenon, but is felt sufficiently far out to sea—70-80 miles out, according to the account of it given in the second chapter of the work—to be a menace in the Bay of Bengal.

In addition to information about the more violent weather phenomena, there is much useful matter relating to ordinary local winds and currents and their seasonal variations, and to tides. The last chapter describes the system of visual storm warnings in force throughout Indian waters.

The handbook is well arranged; the standard of printing is adequate, while the maps are clear in spite of their small size. It is not easy for a reviewer in Great Britain to accept the Director-General of Observatories' request for practical suggestions for increasing the usefulness of future editions—unless of course it is proposed to increase its length, in which case much additional information about local peculiarities in the weather could doubtless be included.

E. V. N.

* India Meteorological Department. Winds, Weather and Currents on the Coasts of India and the Laws of Storms. Pp. iii+51 and 18 plates. (Calcutta: Gov. of India Central Pub. Branch, 1931.) 2.0 *Rs.*; 4*s.* 6*d.*

Electric Discharge in Gas at Low Pressure

DR. I. LANGMUIR presented an interesting review of the electrical properties of the discharge in gas at low pressure, at the recent International Electrical Congress held at Paris. The advances made in this field in the last nine years, which have completely revolutionised our outlook, have come largely from his laboratory and from that of Prof. K. T. Compton.

In his recent paper, Dr. Langmuir confined himself to a statement of the more important mathematical relations which have been developed to give a starting point, somewhat simplified still in comparison with reality, for the investigation of discharges. In these there are two fundamental conceptions, that of a 'sheath' and that of a 'plasma'. Sheaths are found in general on the surfaces of electrodes or on the walls of the tubes, and are essentially regions in which there is a strong separation of charges of one sign. In practice these are usually positive, but by control of the potential of the solid boundary, they may be made of the opposite sign. The potential within them is governed by the well-known Poisson equation for the divergence of the electric intensity, and the currents across them determined chiefly by the rate at which particles from the main discharge diffuse to their boundaries.

The plasma is, on the contrary, a region in which the concentrations of electrons and positive ions are almost equal and opposite, and usually both large, of the order of 10^{8} to 10^{13} per c.c. It has thus a high conductivity, in distinction to the sheaths, and almost invariably in the discharges studied by Dr. Langmuir, has exhibited the peculiarity that the distribution of velocities amongst the electrons in it has been Maxwellian, with a temperature between 5000° and 100,000°. The determination of these temperatures, and the simultaneous analysis of other features of the plasma, is perhaps the most valuable contribution to a more general theory of discharges from this work, and can be accomplished by taking the current-voltage characteristic curves for an exploring electrode. At the present time, the chief advances are being made as a result of the departures which have been observed from Dr. Langmuir's original theory of exploring electrodes, and it is clear that the conception of an electron temperature will have to be modified in certain cases.

It is interesting to notice that there are two distinct reasons why parts of a discharge tube may be non-luminous, or almost so. One is, that a sheath is present; and the other, that although in a plasma, which is usually brightly luminous, the discharge is being carried by diffusion, often in a reversed electric field, so that the electrons are not acquiring sufficient energy to excite or ionise the molecules of gas.

Calendar of Geographical Exploration

Sept. 27, 1874.—Crossing Western Australia

J. Forrest reached the overland telegraph line, which had been carried from Port Darwin to Adelaide in 1872, after a journey which began at Perth. He had followed the Murchison River and, after that, a line of springs. By August this source of water had given out, and it was with the utmost difficulty that he achieved his object and reached the line south of the Alberga River, thus completing the link between the coast lands of the west and the central regions. In 1869, Forrest had proceeded from Perth to the region west of Lake Barlee, and in 1870 had followed Eyre's route in the south, starting, however, from the west.

Sept. 28, 1791.—Coastal Surveys in Australasia

A French expedition under Bruni d'Entrecasteaux left Brest to search for La Pérouse. Surveys were carried out in Tasmania and New Caledonia, Bougainville Island was visited, and Amboina was reached through the strait between New Britain and New Ireland. The south coast of Australia was charted to 131° 30′ E., and the islands east of New Guinea, with the coast of New Guinea itself, were charted. Shortly after surveying New Britain, d'Entrecasteaux died. The explorer's careful work did much to fill in the details of this region of the Pacific. A competent scientific staff accompanied the expedition, the naturalist, Labillardière, afterwards publishing his records, while the hydrographers, Rossel and Beautemps-Beaupré, published the journal of d'Entrecasteaux and the charts of the coasts visited.

Sept. 30, 1500.—Brazil and the Mouth of the Amazon

Vicente Yanez Pinzon, who had formerly sailed with Columbus, reached Spain after a voyage which had been successful from the point of view of discovery, though two out of his four vessels were lost in a storm. He sailed in December 1499 from Palos, passed the Cape Verde Islands, and penetrated so far to the south-west that he lost sight of the pole star. On Jan. 20, 1500, he sighted the Brazilian Cape of San Agustin. Pinzon was the first to land on the American continent south of the equator, his farthest south being 8° 20′ S. In April of the same year the Portuguese, Cabral, also sighted the coasts of Brazil. Following the coast northward to the equator, he discovered the mouth of the Amazon, finding the water still fresh forty leagues out at sea.

Societies and Academies

London

Institute of Metals * (Annual Autumn Meeting), Sept. 14.—**C. E. Ransley** and **C. J. Smithells**: Mechanical properties of nickel wires. The materials used include commercial nickel, refined nickel prepared by melting in hydrogen, and the same material with small additions of the elements commonly present in commercial nickel.—**H. J. Gough** and **D. G. Sopwith**: Atmospheric action as a factor in fatigue of metals. A review of the literature of corrosion fatigue reveals many apparent inconsistencies, but a closer examination indicates that such is not the case. It is shown directly that atmospheric corrosion enters, to a varied extent, into the mechanism of fatigue as exhibited during the usual type of fatigue test in which the surface of the specimen is exposed freely to the atmosphere.—**G. I. Taylor** and **H. Quinney**: The distortion of wires on passing through a draw plate. Composite copper wires ½ in. in diameter, each consisting of two wires of semi-circular section, were pulled through various draw-plates. Photographs are reproduced showing the distortion of the cross-sections. These are treated in a quantitative manner, measurements of the ratio of distortion to increase in length being found for various reductions in area and angle of taper.—**H. W. Brownsdon** and **L. C. Bannister**: A modified impingement corrosion apparatus. Owing to difficulties experienced with apparatus hitherto used for carrying out impingement corrosion experiments, a modified apparatus has been devised which is simple in design and permits of the ready control of the many factors influencing this type of corrosion; details are given regarding its construction and use.—**W. H. J. Vernon**: The open-air corrosion of copper. (3) Artificial production of green patina. Treatment with ammonium sulphate solution followed by a solution in which basic copper sulphate is suspended gives a green patina, which, however, breaks down under severe weather conditions. A patina stable under the latter conditions is produced by anodic treatment for 15 minutes in a suitable electrolyte; it has a good green colour and is quite insoluble in water. Certain synthetic coatings other than basic copper sulphate, although initially green, readily blacken on free exposure to town air. The application of linseed oil, and more especially of lanoline, to the primary coating gives marked protection to the underlying metal, but does not prevent discoloration; water glass and silicon ester, on the other hand, appreciably increase the corrosion.—**K. L. Meissner**: Two years' corrosion tests with duralplat in the North Sea. The specimens consisted of strips of four different thicknesses, drawn profiles of two thicknesses, and riveted strips. With the exception of the last mentioned, all samples were exposed in two series, that is, at ebb and flow of the tide, and always under water. Samples were taken every three months.—**T. G. Bamford**: The properties of commercial varieties of copper at high temperatures. Five typical commercial coppers were examined. All these varieties were capable of resisting shock extremely well up to 400° C., and with one exception—that of tough-pitch arsenical copper—impact strength was well maintained up to 600° C. In general, nickel-copper has the greatest, and tough-pitch pure copper the least, capacity for withstanding alternating stresses at elevated temperatures, although the capacity varies considerably from one temperature to another. Nickel-copper has exceptionally high endurance at a temperature of 560° C.

* Continued from p. 446.

Paris

Academy of Sciences, Aug. 8 (vol. 195, pp. 405-428).—**Gabriel Bertrand** and **Georges Brooks**: The constitutional formula of laccol. The authors have obtained laccol in well-defined crystals, have prepared its tetrahydro-derivative, and have converted the latter into the diacetate. Laccol is a derivative of pyrocatechol, $C_6H_3(OH)_2C_{16}H_{29}$.—**J. Schokalsky**: The fluctuation of the arctic climate. Evidence that during the last thirty years the Atlantic current has carried an enormous mass of warm water into the polar basin. As a result, there is now a period of a milder polar climate.—**N. Cioranesco**: Some properties of polyharmonic functions in correlation with certain properties of polynomials.—**L. Tchakaloff**: A property of trigonometrical polynomials.—**F. Marty**: The group of automorphy of certain integral functions.—**A. Silveira** and **E. Bauer**: The Raman effect in saline solutions.—**Duffieux** and **Léon Grillet**: A sensitometric arrangement with cylindrical lens and dia-

phragm in profile.—**Léon Gion**: The photochemical oxidation of aqueous solutions of ammonia. Ammonium nitrite results from the oxidation, and this is decomposed photochemically.—**Astruc and Mousseron**: The double sulphate of aluminium and sodium. The existence of sodium alum is clearly proved, but it is only a true double salt between the temperatures 11° C. and 39° C.—**V. Frolow**: The condition of the dissolved salts in the waters of the rivers of the Damas region.

CRACOW

Polish Academy of Science and Letters, June 11.—**Georges Bouligand**: The essential isolated singularities of a harmonic function and various associated problems.—**S. Mazurkiewicz**: Ensembles of unicity.—**S. Szczeniowski**: The probability of the passage of an electron in a region of negative energy.—**Mlle. J. Goworecka** and **M. Hlasko**: The electrolytic conductivity of the alkali metal hydroxides in water and the mobility of the hydroxyl ion. The limiting conductivities of lithium, sodium, and potassium hydroxides have been determined, the values found being higher than those generally accepted.—**K. Dziewoński** and **Cz. Piasecki**: Syntheses of the monosulphonic derivatives of acenaphthenequinone.—**K. Dziewoński** and **Mlle. Z. Zalewska**: A new method for the synthesis of dinaphthopyrone.—**A. Swaryczewski**: The *d*-tartrate of guanidine: crystallographic study.—**J. Zerndt**: An attempt at the determination of the age of the blocks of coal from the Carpathian Flysch by means of the megaspores.—**W. Tad. Dominik**: The relation between the formation of crystals of calcium oxalate in certain Coniferæ and the fall of the leaves. —**Z. Kolodziejski**: Study on the regeneration of the pedal disc in *Actinia equina*.—**J. Zaćwilichowski**: The innervation and the sensitive organs of the oviscapt in *Allantus arcuatus* (Tenthredinoidea).

GENEVA

Society of Physics and Natural History, June 2.—**Ch. H. Wakker** and **E. Briner**: Researches on the chemical action of electric discharges: improvements in yields realised by using light metal alloys as electrodes. The presence of alkali or alkaline-earth metals in the electrodes of arc furnaces considerably increases the energy yields in the production of various substances, especially nitric oxide.—**Ch. H. Wakker, E. Briner**, and **H. Paillard**: Researches on the production of nitric oxide in an arc furnace working with electrodes of light metal alloys. The improvements in the energy yields in the production of nitric oxide by means of the arc realised by incorporating small proportions of the alkali or alkaline earth metals in the electrodes are reproduced in a furnace using 2-4 kilowatts and with arcs 40-60 cm. in length.—**A. Lombard** and **A. Coaz**: The limit between the Jurassic and the Cretaceous from the Col des Aravis to the Col du Sageroux, Haute Savoie. The authors have recognised the existence of a zone of passage in the fauna of which the true Jurassic forms progressively disappear. There is no clear-cut line between the two periods.—**D. Zimmet** and **Ch. Yung**: The difference between the nitroprusside reaction for glutathione and acetone: the effect of the hydrogen ion concentration. Sodium nitroprusside gives a rose-violet colour with glutathione and with acetone, but whilst the first reaction is produced immediately and reaches a maximum at pH9, the reaction with acetone is not produced with pH less than 9 and is slow between pH9 and pH10. Reagents are proposed for detecting glutathione even when acetone is present. —**D. Zimmet**: A new reaction of glutathione. Oxidised glutathione, like cystine, gives a persistent rose-violet coloration with silver nitrate and dimethyl-p-phenylenediamine. These two reagents alone give only a fugitive tint. Reduced glutathione prevents any coloration, unless it is first left in contact with silver nitrate.

ROME

Royal National Academy of the Lincei, April 3.—**F. Severi**: A fundamental property of the fields of holomorphism of an analytical function of one real variable and one complex variable.—**P. Burgatti**: A classification of the linear equations of the second order to the ordinary derivatives founded on recurrent relations.—**G. Fubini**: A theorem on the equations to the partial derivatives of elliptic type which generalises a theorem of Hartog and one of Severi.—**M. La Rosa**: The supposed reality of the Lorentz contraction and the determination of the absolute motion of the earth. —**A. Pochettino**: The Hallwachs effect of compounds of elements with two-fold valency. Whereas, in general, Mn^{III} and Mn^{VII} ions tend to undergo transformation in the light into Mn^{II} and Mn^{VI} ions respectively, manganous hydroxide becomes changed into manganic hydroxide. Whilst calomel shows a tendency to become converted in the light into corrosive sublimate, this undergoes the reverse change under similar conditions, so that an equilibrium is established between the two; the same thing happens with cuprous and cupric chlorides. In general, with various pairs of analogous compounds, the greater Hallwachs effect is always shown by that compound in which the element of variable valency has the lower valency, independently of the sign of the ion in which the element appears.—**M. Betti** and **P. Pratesi**: Chemical constitution and rotatory power: Derivatives of chloro- and bromo-benzaldehydes. The anomalies displayed in the values of the dissociation constants of chloro- and bromo-benzoic acids are reflected in the rotatory powers of corresponding aldehyde *o*-derivatives. Thus, the dissociation constants of benzoic, *o*-chloro-, and *o*-bromo-benzoic acids are 0·006, 0·132, and 0·145 respectively, and the molecular rotations of the compounds formed by benzaldehyde, *o*-chloro-, and *o*-bromo-benzaldehyde with *d*-β-naphtholphenylaminomethane are +373·1°, −128·4°, and −308·7° respectively. Similar results are furnished by the meta- and para-derivatives, all the data indicating that, in these compounds, bromine is distinctly more highly electro-negative than chlorine. —**U. Broggi**: Complete linear differential equations with constant coefficients.—**A. Masotti**: Relations between the curvatures of two corresponding lines in a conform representation.—**J. Rey Pastor**: Topology of the dominions of a space of n dimensions.—**P. Rocher**: Lines of greatest slope of Green's function. The fact that the arc of greatest slope of Green's function, passing from the pole A to any point B of the domain, does not depend symmetrically on A and B, is extended to Euclidean spaces of more than three dimensions.—**Ruy Luis Gomes**: The existence of the normal derivative of a simple layer potential.—**L. Campedelli**: Certain noteworthy double planes with curve of branching of the tenth order.—**G. Palozzi**: Some results of projective-differential geometry.—**G. Colonnetti**: Influence of the shearing force on the deflection of a beam. Mesnager's statement that the elastic deflection of an inflected beam does not depend on the shearing force, is shown to be erroneous.—**A. Rosenblatt**: Laminary movements of incompressible viscous liquids (4).—**A. Occhialini** and **L. Gallino**: A reproducible sphinterometer for quantitative spectroscopy. For quantitative spectroscopic purposes, use may be made of the fact that a radiation emitted, on the passage of a spark, from a metal contained in an electrode is derived from a region adjacent to the electrode and of length varying with the richness in

the electrode of the metal considered. The instrument described depends on this principle.—**P. Straneo**: Energetic tensors in the unitary theory of absolute geometrisation.—**G. B. Bonino and P. Cella**: Raman spectrum of certain derivatives of aniline. The presence of a C : N linkage in a molecule results in the appearance in the Raman spectrum of one or two lines between 1400 cm.$^{-1}$ and 1500 cm.$^{-1}$. These lines cannot be confused with the lines 1430 cm.$^{-1}$-1450 cm.$^{-1}$ of the CH_2 group, which does not occur in the compounds examined.—**G. B. Bonino and P. Cella**: Raman spectrum of Δ^2-dihydronaphthalene. This spectrum exhibits lines in complete accord with the structural formula, if the spectra of naphthalene, decaline, and tetraline are taken into account. The line 3041 cm^{-1} of the aromatic C-H group occurs also with tetraline and naphthalene, and the lines 2873 and 2825 observed are attributed to CH_2. The line 1663 is lacking with tetraline, decaline, and naphthalene and is characteristic of the double ethylene linkage; the line 1433 is the characteristic CH_2 line but is displaced by 20 units from the typical CH_2 line.—**G. Piccardi and A. Sberna**: Molecular spectra and spectroscopic analysis (4): scandium. The method previously described allows of the ready and certain detection of 5 parts of scandium per 100,000, its superiority over ordinary spectroscopic methods being confirmed.—**F. De Carli**: (1) Solubility of calcium gluconate in the presence of sodium phosphate and of arsenious acid. Sodium phosphate has a less effect than boric acid in increasing the solubility of calcium gluconate, the most concentrated solution obtainable containing 7·26 per cent of the gluconate and 41·62 per cent of the phosphate. A 5 per cent solution of arsenious anhydride dissolves 9·29 per cent of the gluconate.—(2) Properties of solutions of calcium chloride and urea. Mixed solutions of calcium chloride and urea contain no molecular associations detectable by the physical methods employed. The therapeutic behaviour of such solutions does not appear to be attributable to specific properties of the compound, $CaCl_2$, $4CO(NH_2)_2$, $2H_2O$, but is probably due to an influence of the urea on the inconveniences sometimes accompanying the hypodermic administration of calcium chloride.—**T. Carpanese**: Granite, vesuvian, ilmenite, and titanite from Monte Rosso di Verra (Monte Rosa group).

VIENNA

Academy of Sciences, June 30.—**Richard Weiss and A. Beller**: Condensation of αα′-diphenyl-ββ′-benzofuran with unsaturated compounds.—**Heinrich Graven**: A method for determining uranium and thorium in minerals (2).—**Heinrich Gräven and Gerhard Kirsch**: The radioactivity of early pre-Cambrian granites from southern Finland. Non-metamorphic intrusions appear to be moderately homogeneous as regards radioactivity, although specimens of outstanding activity occasionally occur. The results obtained with these granites are, in general, comparable with those found by Mache and Bamberger for the central gneiss of the Alps.—**Hans Pettersson and Josef Schintlmeister**: Atomic fragments of small range from rare gases.—**Georg Koller**: A synthesis of methyl diacetylevernate and of methyl tetra-acetylgyrophorate.—**F. Lauscher, F. Steinhauser, and M. Toperczer**: Profile of the intensity of the sun's radiation through the Styrian and Lower Austrian Alps. At the time the observations described were made (July 30-Aug. 2), the atmospheric dew of the E-N-E. air-movement led to the formation of a layer of vapour at the cumulus level over the whole pre-Alpine region. Hence the intensity of the solar radiation in the higher parts of the pre-Alpine district was somewhat below that of the inner Alpine valleys. At medium heights (about 1000 metres), the mountain air weakened the radiation about ten times as much as absolutely pure air, this observation agreeing with those made elsewhere. At about 700 metres the weakening was fifteen-fold and at 450 metres twenty-two-fold.—**H. Kun and H. Burchardt**: Non-specific actions of the female sexual hormone (progynon). With senile or prematurely old male rats, regular subcutaneous injection of progynon has the same effects as with the females: growth of hair on bald or thin regions and increase of the contents of hæmoglobin and red corpuscles in the blood.

Official Publications Received

BRITISH

The British Mycological Society Transactions. Edited by J. Ramsbottom, B. F. Barnes and H. Wormald. Vol. 17, Parts 1 and 2, 11 August. Pp. 156. (London: Cambridge University Press.) 15s.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 64: The Ripening and Transport of Bananas in Australia. By Prof. W. J. Young, Prof. L. S. Bagster, E. W. Hicks and F. E. Huelin. Pp. 52. (Melbourne: H. J. Green.)

Transactions of the Mining and Geological Institute of India. Vol. 26, Part 4, June. Pp. 277-347 + xii + plates 27-33. 4 rupees. Vol. 27, Part 1, July. Pp. 86. 4 rupees. List of Members, 1932. Pp. 26. (Calcutta.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 71, No. 428, August. Pp. 285-404+xii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Journal of the Royal Statistical Society. New Series, Vol. 95, Part 3. Pp. viii+393-606. (London: Royal Statistical Society.) 7s. 6d.

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein) for the Year ending 31st December 1931. Pp. 31. (Kirstenbosch.)

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 4, No. 1, March. Compiled by Agnes Elisabeth Glennie. Pp. iv+135. (London: H.M. Stationery Office.) 2s. 6d. net.

Journal of the Society of Glass Technology. Edited by Prof. W. E. S. Turner. Vol. 16, No. 62, June. Pp. xii+33-68+111-253+139-290+xxiv. (Sheffield.) 10s. 6d.

Report of the Progress of the Ordnance Survey for the Financial Year 1st April 1931 to 31st March 1932. Pp. 19+6 plates. (London: H.M. Stationery Office.) 3s. 6d. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1487 (T. 3157): Pitot-Static Tube Factor at Low Reynolds Numbers. By E. Ower and F. C. Johansen. Pp. 28 + 10 plates. (London: H.M. Stationery Office.) 1s. 6d. net.

Scottish Society for Research in Plant-Breeding. Report by the Director of Research to the Annual General Meeting, 20th July 1932. Pp. 29. (Edinburgh.)

FOREIGN

Norges Svalbard- og Ishavs-Undersøkelser: Meddelelser. Nr. 12: i. Norske Undersøkelser ved Sydpollandet 1929-1931; ii. *Norvegia*-Ekspedisjonen 1930-1931. Av Gunnar Isachsen. Pp. 345-366. Nr. 13: Norges Svalbard- og Ishavs-Undersøkelsers Ekspedisjoner Sommeren 1930; Ekspedisjonen til Jan Mayen og Øst-Grønland, av Anders K. Orvin; Ekspedisjonen til Svalbardfarvannene, av Rolf Kjær; Ekspedisjonen til Spitsbergen, av H. Frebold; Ekspedisjonen til Franz Josefs Land, av Gunnar Horn. Pp. 367-405. Nr. 14: The Fossil Wood from the Tertiary at Myggbukta, East Greenland, by Ove Arbo Høeg; A Fossil River Bed in East-Greenland, by Anders K. Orvin. Pp. 303-474+8 plates. Nr. 15: Landets Senkning i Nutiden på Spitsbergen og Øst-Grønland. Av Thorolf Vogt. Pp. 563-574. Nr. 16: Blütenbiologische Beobachtungen aus Spitzbergen. Von Ove Arbo Høeg. Pp. 22. Nr. 17: Notes on some Arctic Fossil Wood, with a Redescription of *Cupressinoxylon polyommatum*, Cramer. By Ove Arbo Høeg. Pp. 9+8 plates. (Oslo: Jacob Dybwad.)

Union Géodésique et Géophysique Internationale. Quatrième Assemblée Générale, Stockholm, Août 1930. Procès-verbaux des séances de la section de Météorologie. 1: Actes de la Section. Pp. 67. (Paris: Impr. Paul Dupont.)

University of California Publications in American Archaeology and Ethnology. Vol. 31, No. 4: Quantitative Expression of Cultural Relationships. By H. E. Driver and A. L. Kroeber. Pp. 211-256. (Berkeley, Calif.: University of California Press.) 25 cents.

Proceedings of the United States National Museum. Vol. 81, Art. 7: Decorative Designs on Elden Pueblo Pottery, Flagstaff, Ariz. By Walter Hough. (No. 2930.) Pp. 11 + 10 plates. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Office of Education. Bulletin, 1932, No. 2: The History of the Municipal University in the United States. By Prof. R. H. Eckelberry. Pp. viii+213+13 plates. Pamphlet No. 29: Official Certificates, Diplomas and Degrees granted in France. By James F. Abel. Pp. 14. (Washington, D.C.: Government Printing Office.)

Contributions to Palaeontology from Carnegie Institution of Washington: Papers concerning the Palaeontology of California, Oregon and the Northern Great Basin Province. (Publication No. 418.) Pp. iii+118+14 plates. (Washington, D.C.: Carnegie Institution.)

Publications de l'Observatoire Astronomique de l'Université de Belgrade. Mémoires 1, 1932. Pp. 47+8 planches. (Beograd.)

Bergens Museums Årbok, 1931. Hefte 2: Naturvidenskapelig rekke. Pp. 54+67+5+20. (Bergen.)

SATURDAY, OCTOBER 1, 1932

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Popularisation and Archæology

A REFERENCE to the widespread interest among the general public in the results of research in the past history of mankind has become almost a commonplace of comment on archæological matters; but few go on to inquire why such an interest should be so marked at the present day, in contrast with, say, the period preceding the War, when, for example, Sir Arthur Evans was engaged in his epoch-making investigations in Minoan Crete. To say that excavations at Ur, in Egypt, or Palestine have had a better Press in the last ten or twelve years than was given to archæology in the ten years before the War, merely begs the question. The popular Press, to which this diagnosis applies particularly, is, in this matter, a symptom of its readers' tastes rather than the cause. It follows rather than guides; but in a mistaken judgment on the situation it is prone to a sensationalism that is superfluous, in so far as its object is to stimulate an interest which already is anxious to be informed.

Actually, it is not the sensational but the familiar combined with the remote in the study of prehistory that in the long run captures the imagination of the plain man. A flint implement, be it five or fifty thousand years old, means no more to him than a useless lump of stone. Everyone, however, at some time in his life has handled a knife, a chisel, or a saw, and when the purpose of the flint implement has been explained to him, or better, when he has handled it for himself, he realises the nature of the problems which confronted his remote ancestors, and the differences in the means at his disposal for dealing with the same or similar problems. In other words, he has grasped perspective in the growth of civilisation, and also its continuity. Henceforth his attitude to the past will have undergone a fundamental change: his interest has been permanently aroused.

If it has been that in the development of archæological studies since the War attention has been directed more particularly to the interpretation of the results of excavation in terms of affiliation, to tracing the movements of races and cultures, inferring racial and cultural contacts and marking consequences in the modification or development of material culture, it is equally true that a more intense application of the results of the sister studies of geology and geography to the problems of archæology—in itself no new thing—also has produced developments which have been of the

first order of importance in stimulating research in the field and in the co-operative elaboration of theory.

The distribution map has long been a familiar implement of the archæologist's laboratory. Expertly interpreted, it has been made to tell the story of trade route and racial movement; but interpreted in the light of geology and geography, it becomes more eloquent still. Dr. Randall-MacIver, in his recent presidential address to the Section of Anthropology of the British Association, discussed the results of recent research on these lines in narrowing down the limits of search for a man's earliest ancestors and in the interpretation of the distribution of the earlier products of human industry. Even more fruitful have been Dr. Cyril Fox's researches in demonstrating how geology, geography, and palæobotany can in combination answer the questions posed by the archæological succession in showing how it came about that certain events fell out where they did, and why development should have taken certain lines. The methods of his book, "The Archæology of the Cambridge Region" (Cambridge, 1923), were demonstrated on the broader canvas of Britain as a whole in his lecture before the recent International Congress of Prehistoric Sciences (see NATURE, Aug. 13, p. 247), when he showed how two distinct geographical areas in Britain reacted differently to intrusive culture, and traced the development of the Briton from uncivilised to civilised with the gradually acquired control of his environment, as shown by the movement of settlement from one type of land to another, and followed the transfer of trade from the line Solent–Salisbury Plain to the Thames basin.

Archæological investigation on this scale is essentially a matter of synthesis of the observations of a number of individuals. It is interesting to note how archæological investigation has been assisted since the War by two Government departments acting in concert and on a scale that would have been a practical impossibility for private effort—in one instance more or less unofficially as a by-product of official activities, in the other as a part of official duties. These departments are the War Office, of which the course of training for the Royal Air Force has afforded opportunities for archæological observation and photography, and the Ordnance Survey, which now carries on its establishment an Archæological Officer.

No single recent development in archæological method has attracted so much public attention as the discovery that it is possible to discern from the air archæological remains of which the presence cannot be detected on the ground. Of the many ancient monuments and remains of which knowledge is due to this method of observation, Woodhenge in Wiltshire is the most important and the most interesting; but the utility of air observation is far from ending there, and the magnificent panoramic series of views of Wansdyke shown at the recent exhibition, illustrative of British archæology in the field, at the London Museum (see NATURE, Aug. 6, p. 196) demonstrated its value not only as a means of record, but also as an aid in the preparation of accurate plans and maps. Those who became familiar with the use of air photographs during the War will appreciate the value of this method of study in arriving at the purpose and plan of earthworks and other forms of enclosure.

The work of the Ordnance Survey has for long been concerned with the record of ancient monuments as part of its normal duties. Indeed, the Survey preserves at its office at Southampton a proof sheet of the original one-inch map of Wiltshire, made more than a century ago, which bears the manuscript archæological corrections of Sir Richard Colt Hoare. Since the first appointment of an Archæological Officer thirteen years ago, its activities in this direction have been much extended, especially in adding to the list of known monuments, both under- and over-ground. More widely known, though still perhaps less than it deserves, is the excellent series of archæological studies of which the first was the map of Roman Britain issued in 1922, Mr. O. G. S. Crawford's "Archæology from the Air" coming later, and the latest addition being the "Map of Neolithic Wessex",* an adaptation of the Quarter-Inch Ordnance Map, Sheet 11, to show the distribution of the long barrows, circles, habitation sites, and flint mines, preceded by thirty-five pages of commentary and schedules of monuments.

Without entering into a discussion of technical detail, it may be said that the interest of the Wessex map, from the point of view of its general educational value, lies in the combination of archæological, geographical, and geological detail, which shows the monuments as they lie in relation to the natural environment of the neolithic period, and at the same time invites contrast and comparison with conditions as they are to-day. A glance at the map as a whole, keeping in view geological formation, shows why settlement was in the main confined to

* Map of Neolithic Wessex. By Ordnance Survey. Southampton, 1932. 4s. net.

certain open spaces. Neolithic man avoided the forest areas, as here reconstructed, and the open heaths, in favour of the broad shallow valleys of the downs, where there were perennial streams, pasture for his sheep, and land suitable for crude cultivation. Here, too, in waterlogged clays and the narrowed strips of forest and their relation to settlement may be seen why communications followed certain lines, while along others traffic was delayed until Roman or even medieval times.

In the compilation of the map of Wessex, the Ordnance Survey was assisted by a body of voluntary helpers. Archæology is at present fortunate in having at its disposal a number of highly skilled unpaid workers; but even so, archæological field-work is normally an expensive undertaking. In these days of economic stress, expenditure which depends for its funds upon assistance from public subscription must justify itself by its works and not by faith. Enough has been said to support the view that the exposition of the results of archæological research to be popular need be neither unscientific nor sensational. An archæology that can continue to stimulate the interest of the general public in the past history of mankind need have no fear for the future and is fully justified of its children.

Philosophy Looks at Science

(1) *Philosophy of the Sciences: or the Relations between the Departments of Knowledge.* By the Rev. F. R. Tennant. Pp. ix + 191. (Cambridge: At the University Press, 1932.) 6*s*. net.

(2) *Philosophical Aspects of Modern Science.* By C. E. M. Joad. Pp. 344. (London: George Allen and Unwin, Ltd., 1932.) 10*s*. 6*d*. net.

(3) *The Approach to Philosophy.* By J. F. Wolfenden. Pp. 236. (London: Edward Arnold and Co., 1932.) 7*s*. 6*d*. net.

MANY criticisms of modern science and of scientific workers to-day relate to their excessive specialisation and the defective sense of values which specialisation is apt to engender. The philosophic views expounded in these three books illuminate the underlying causes of such defects and are of further interest from the picture they give of science as viewed and appraised by the philosophers.

(1) In the "Philosophy of the Sciences" the relations between the departments of knowledge are discussed and attention is directed to various dangers attending specialisation or, as Dr. Tennant terms it, "departmentalism". The one aspect of the facts on which the specialist concentrates is sometimes treated as if it were the only aspect, and again, disparities or discontinuities are assumed where knowledge of other fields would indicate continuity or compatibility. This danger is the more serious when experts in one sphere of knowledge make incursions into other spheres in which they are not equally at home, and thus are apt to propagate erroneous beliefs. Dr. Tennant has obviously in mind mathematical and physical exponents of the theory of relativity, whose theories are criticised in detail from a similar point of view by Mr. Joad.

Dr. Tennant observes wisely that "the history of science forewarns us, and the philosophy of the sciences can forearm us, against confounding utility for the purpose of an abstract and special science with significance for the interpretation of knowledge in its comprehensiveness, as to the world, in its concreteness". Accordingly, Dr. Tennant argues for a philosophy of the sciences which shall be able to undertake this task of mediation. By a philosophy of the sciences we are to understand not a science of the sciences, as suggested by Spencer, or a classification of them according to their subject matter, or even a comprehensive survey attempting to sum their generalisations, but a sifting of the methods and products of the special sciences which will enable us to grasp the main features of the world and to relate them as parts of one whole. The resultant systematic arrangement of the sciences according to their dependence one on another is what the author understands by a philosophy of the sciences.

Essentially, therefore, we have in Dr. Tennant's book an attempt to capture real values, the absence of which has doubtless much to do with the present chaotic condition of the world under the impact of applied physical science. To this defect Dr. Tennant obviously refers when he reminds us that "between science and the world stands human nature. . . . The world is knowable only to an extent determined by the range of human faculties and only in a manner that is conditioned by their distinctively human nature." From this we are led to the somewhat unorthodox view—which, however, is supported by Dr. Charles Singer's address to the second International Congress of the History of Science and Technology last year—that history, in the wider sense, takes the first place in the systematic order of the departments of knowledge dealing with what is known, as distinct from our knowing, its matter determining all the other sciences, and it also

prescribes the method which philosophy, as distinct from a pure science, must follow.

In support of this view, it is urged that all sciences begin with the historical and empirical facts as they are constituted at the level of philosophical organisation denoted by common sense, and that philosophy, which aims at seeing things whole and as a whole, cannot take its departure from sciences which owe their very existence to leaving out much of the stuff of knowledge because it is not scientifically manageable by them or is irrelevant to their business. The relation of history to science is discussed, and the claims of history to be a department of knowledge, although it is not an experimental science, are based on its being more than a mere inventory of items of fact; for it involves a critical sifting of its primary data, and the process of selection with which historical research passes into historiography is parallel with processes which occur in natural sciences in evolution and survival of individual hypotheses or theories.

Psychology, theory of knowledge, and history indeed reveal the presuppositions of physical science and set the bounds to its scope and functions, and only when its relations to them are appreciated can the true nature of scientific knowledge be appreciated. Dr. Tennant carries his arguments further and discusses the broad differences between theology and science, claiming that once it is recognised that all knowledge of the actual world is pre-eminently interpretative, the concepts and categories required by the historical sciences can be involved with as much right as the fewer and more formal categories by the pure sciences.

(2) Mr. Joad's discussion of philosophical aspects of modern science is more from a metaphysical point of view, but his criticism of the theories of modern physicists, although more detailed, is in general similar to Dr. Tennant's and leads him to a point of view not dissimilar. The conceptions of the physical universe sponsored by modern science are changing with extreme rapidity but are all extremely remote from the world of common sense, so that the question of their real status and other strictly philosophical questions arise. It is the business of philosophy to correlate the evidence collected by the special sciences and to try to fit it into a coherent scheme of the universe as a whole. Moreover, the vision of the artist, the religious consciousness of the saint, and the day-to-day experience of the plain man are equally facts of which philosophy must take cognisance. This urgent task of correlation and humanisation demanded by the changing conceptions of modern physics is not made easier by the increasing disposition of men of science to enter the domain of philosophy, and Mr. Joad reviews in detail the views of Eddington, Jeans, and Bertrand Russell in relation to a theory of scientific knowledge which forms the main part of the book. The philosophies of the universe based upon the interpretation of modern physics are open to objection because they regard the familiar world of sense experience as not objectively real but in some sense a product of the observer's mind. Similarly, they regard the world of modern physics as not objectively real but in some sense a product of the scientific worker's reading; and they despise brute collections of given fact and seek to analyse them away into mind or law. Starting from certain premises—what the plain man perceives and what science has discussed—they reach conclusions which suggest that the premises are misleading, in the sense that the plain man does not perceive what he thinks he perceives, and the discoveries which science has made do not truly represent the nature of what is.

These mistakes, Mr. Joad suggests, arise not from false science but from a false theory of knowledge, and he considers that eminent men of science misconceive the nature of the act of knowing and the nature of its relation to the object known. The most important part of the book is, however, not its attempt to clear up the muddle of the relation of the world of science and of common sense, but its discussion of the question of values, including the moral, æsthetic, and religious values. Religion and science are each a legitimate avenue for the exploration of reality, but of different orders of reality, and in Mr. Joad's view the researches of the scientific worker equally with the perceptions of the plain man, the moral consciousness of the good man, the sensitivity of the artist, and the religious experience of the mystic are revelatory of reality. Philosophy in its endeavour to understand every aspect of the universe is thus both a bar to which the various methods of obtaining information about the universe may be called to give an account of themselves, and also a clearing-house in which different forms of experience may be pooled. Mr. Joad's sympathetic treatment of science lends the greater force to his criticisms and exposition of the limitations of scientific method, and he wisely reminds us: "Science is still a new thing and man is still inapt in its use".

(3) Mr. Wolfenden writes an eminently readable introduction to philosophy, in which its relation to science is discussed in a vein very similar to that

of Dr. Tennant and Mr. Joad. There is very little attempt to make a personal contribution to a solution of the problems which vex mankind, but this rapid and concise review of the territory of philosophy should be of real assistance to scientific workers who are anxious to gain a sense of the value and position of science and its methods. Without such perspective, science can never take its natural place as part of the life of either the individual or of the nation, and the absence of effort to attain that perspective is commonly due at least as much to mental laziness as to the erroneous assumption frequently made by scientific workers, that the scientific method is the only way of finding out anything about anything and necessarily opposed to any other method or direction of inquiry. In addition to differentiating carefully between science and philosophy and their respective methods, Mr. Wolfenden makes a bold claim for philosophy as constructive.

Internal Combustion Engines

(1) *Internal Combustion Engines.* By Prof. J. A. Polson. Pp. vii + 475. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 25*s*. net.

(2) *Automobile Engines in Theory, Design, Construction, Operation, Testing and Maintenance.* By Arthur W. Judge. (Motor Manuals: a Series for all Motor Owners and Users, Vol. 1.) Second and revised edition. Pp. 220. (London: Chapman and Hall, Ltd., 1931.) 4*s*. net.

(3) *Principles and Problems of Aircraft Engines.* By Minor M. Farleigh. Pp. xi + 277. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 15*s*. net.

(4) *Heavy-Oil Engines of Akroyd Type: being Developments of Compression-ignition Oil Engines, including Modern Applications to Land Purposes, Marine and Airship Propulsion, and Railway Traction.* By Prof. William Robinson. Pp. xv + 142 + 16 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1931.) 7*s*. 6*d*. net.

A CENTURY ago there were neither gas nor oil engines; to-day they are counted by the tens of millions. Indispensable for the navigation of the air, the internal combustion engine has effected a revolution in road transport, it has successfully challenged the supremacy of the steam engine at sea, it has found its way on to the railroads, and it has for many years been a valuable ally of the steam engine and the water engine for the production of power for public and industrial use. In these circumstances, it is not surprising that the literature dealing with it is becoming very extensive, and that books are written regarding it, for many purposes and to suit many needs.

(1) One class of such books is represented by Prof. Polson's textbook, written for engineering students who know something about thermodynamics and the construction of internal combustion engines, but who stand in need of a general treatise on the theory and practice of this branch of engineering. There are chapters on the thermodynamics of the Otto and Diesel cycles, gaseous fuels, blast furnace gas engines, engines for motor cars, aeroplanes, ships, and power houses, and on the various appurtenances of such engines. The engines dealt with are mainly of American manufacture, and the book includes a chapter on the testing of internal combustion engines with the code of the American Society of Mechanical Engineers.

(2) and (3) Of an entirely different character are the books of Mr. A. W. Judge and Mr. M. M. Farleigh. In these there are no mathematics and little thermodynamics, but a great deal suitable for those who have to run and maintain the engines of motor cars and aeroplanes. After chapters on the combustion process and the petrol engine, Mr. Judge deals with types, lubrication, cooling, testing, maintenance, and timing of automobile engines of British make; and there is no owner or driver of a motor car who will fail to find something of interest or value in what he says.

Mr. Farleigh's book is written in non-technical form, so far as the subject allows, and is primarily intended for the licensed mechanic, the licensed pilot, the operator, and the student who desires to qualify as a mechanic or pilot. One informative chapter is that on "Trouble Shooting". Men for such work, he says, must be "men of keen intellect, imaginative, resourceful, enthusiastic, and above all wholly conscious of the importance of their work". His list of "unusual troubles" is evidence of the importance of small things, while his "cases" show how difficult it is even for experienced men to diagnose the trouble quickly.

(4) The fourth of these volumes under notice, we imagine, has been written with a desire to see that full credit is given to an inventor, Herbert Akroyd Stuart, whose name should be as familiar as that of Diesel. Stuart was born in 1864 and died in 1927; Diesel was born in 1858 and died in 1913. Their pioneering work on oil engines was contemporary but independent. The engineering world has made

great use of the work of both, and practically all heavy-oil engines of to-day are descendants of the original Stuart or Diesel engines. Both were compression-ignition engines and in both engines the oil fuel was injected into the cylinder in a spray, but whereas Diesel for this purpose used highly compressed air, Stuart used 'airless-injection' as it has now been termed. Most modern oil engines use airless-injection. Not a little confusion has been caused by the Stuart engine being called an Akroyd engine, the only instance, we are aware of, of an inventor's Christian name and not his surname being given to his invention. Many engineers are fully conversant with Stuart's work, but others are not, and in the index to Prof. Polson's book is found neither the name Stuart nor Akroyd.

Stuart's work should certainly be known to American students, for the Hornsby-Akroyd engine was introduced into the United States so early as 1893, at a time when the Diesel engine was still being experimented with in the shops of the Maschinenfabrik Augsburg, Nürnberg (now known as "M.A.N."), and of Messrs. Krupp. Prof. Robinson knew Stuart intimately, and his book is not only an up-to-date review of heavy-oil engines of Akroyd type, but also an authoritative history of the subject.

Magnetism and Quantum Mechanics

The Theory of Electric and Magnetic Susceptibilities. By Prof. J. H. Van Vleck. (The International Series of Monographs on Physics.) Pp. xii + 384. (Oxford: Clarendon Press; London: Oxford University Press, 1932.) 30*s*. net.

THE development of a scientific theory involves the interplay of observation, reasoning, and imagination. Experimental results are co-ordinated by generalisations of ever-widening scope through those imaginative leaps which place scientific method, as a whole, outside the scope of strict logic. The generalisations can then be regarded as premises on which may be built a deductive scheme, in which logical consistency is of paramount importance—logical consistency, in theoretical physics, appearing as mathematical rigour. The reasoning, however, is barren, scientifically, unless the deductions are confronted, as 'predictions', with experimental findings. If there is continued agreement, the premises take rank as a scientific theory.

Quantum mechanics, though it may not yet have reached its final form, has developed quite normally along these lines. The experimental findings with which it has been most prominently associated, both in its quasi-inductive and deductive aspects, have been those in the field of spectroscopy. Phenomena other than the purely spectroscopic, however, played an important part in the building up of the theory; and now that general postulates have been reached the range of application of which in connexion with spectroscopy has been amply demonstrated, interest centres in the development of their consequences for application in other fields. "A theory is most 'physical'", Van Vleck observes, "when it permits the calculation of a large number of experimentally observable quantities in terms of a few fundamental postulates", and this point of view characterises his presentation of the central theme of his book—the quantum-mechanical theory of magnetic and electric susceptibilities.

The book opens with four chapters dealing with classical theory. An admirable discussion is given of the relation between the macroscopic and microscopic field equations; the Lagrangian and Hamiltonian functions appropriate when electric and magnetic fields are present are derived; and the relevant results of statistical mechanics are outlined. These preliminaries lead up to the classical derivation of the Langevin-Debye formula for susceptibility due to polar molecules. The experimental results on dielectric constants and refractive indices are considered in a well-documented chapter with reference to the determination of the permanent and induced molecular moments. The analysis of these results on a classical theory basis is justified because the new quantum mechanics restores the validity of many of the classical results for electric susceptibility. The Langevin theory of magnetic susceptibility, however, rests on the classically unjustifiable assumption of molecules having 'permanent' magnetic moments, and a rigorous application of classical principles leads to the prediction of zero susceptibility, a result which is clearly explained. The difficulties and inadequacies of the old quantum theory of magnetic susceptibility are then discussed.

Quantum mechanical theory, including the perturbation 'machinery', is developed with all necessary detail, particular attention being paid to the relation between the wave and matrix methods, a combination of which, in Van Vleck's hands, has proved a powerful weapon in dealing with the problems under consideration. Application is made to the dielectric constants and diamagnetic susceptibilities of atoms and ions, the paramagnetism of free atoms and rare earth ions, the para- and diamagnetism of free molecules, and the para-

magnetism of solids, particularly salts of the iron group. Heisenberg's theory of ferromagnetism is then discussed, and also the theory of the magnetic effects of 'free' electrons. Finally, a brief summary is given of related optical phenomena.

The mathematical difficulties which arise when the attempt is made to obtain numerical results, other than the roughest approximations, from the application of quantum mechanical theory even to relatively simple systems, is well known. Van Vleck's treatment is characterised by the boldness and thoroughness with which these difficulties have been met. This is particularly marked in his own considerable contributions to the subject—as in connexion with the temperature dependence of the susceptibility of nitric oxide, with the paramagnetism of the rare earth ions (which cleared up in a most satisfying manner the discrepancies between the experimental values and those given by the approximate theory), and with the susceptibility of hydrogen. The theory of the magnetic, and also electric, susceptibilities of media which can be treated as consisting of free atoms, ions, or molecules can now be presented as a consistent, rounded whole.

For more extended application to solids generally, it is necessary to consider the effect of interactions, of which one type is the 'interchange' interaction of Heisenberg's theory of ferromagnetism. A further considerable advance has been made by Van Vleck in showing that, owing to interatomic forces, there may be a partial or complete 'quenching' of the orbital moment effect, this giving theoretical justification to a previously suggested explanation of the peculiar paramagnetic characteristics of salts of the iron group.

Van Vleck's book, owing to the inherent difficulties of the subject matter, will not be found easy reading, especially by non-mathematical readers. Its peculiar value lies in the skill and completeness with which details are filled in; it is admirably lucid, and the reader is, as it were, carried on by Van Vleck's own enthusiasm for clearing up minor as well as major points. The footnote references are numerous, and work other than that of the author receives adequate discussion. There is throughout a welcome absence of dogmatism and of that suggestion of finality which is often so irritatingly conveyed in theoretical works; moreover, excellent reviews are given of experimental results. The book is a most valuable contribution to the study of magnetic and electric susceptibilities and to quantum mechanical theory.

E. C. S.

Applied Statistics

(1) *The Methods of Statistics: an Introduction mainly for Workers in the Biological Sciences.* By L. H. C. Tippett. Pp. 222. (London: Williams and Norgate, Ltd., 1931.) 15*s.* net.

(2) *The Combination of Observations.* By David Brunt. Second edition. Pp. x + 239. (Cambridge: At the University Press, 1931.) 12*s.* 6*d.* net.

STATISTICS is a subject which has grown very rapidly during the last twenty years, and it is therefore inevitable that the textbook should tend to depart more and more from the traditional form. The emphasis has somewhat changed, and the need to-day is to cater for the growing public that desires to know something of the practical tests that may be applied to the numerical results of experimental work, in which the sample is not usually very large. In particular, the present-day biological worker is characterised by a thirst for knowledge of the *results* of statistical research, combined with a stoical indifference to the mathematics used to bring about these results. The sampling problems that serve as a basis for the practical tests are of some mathematical difficulty; nevertheless, they are of fundamental importance, and the ideas tend to be introduced at a much earlier stage than has hitherto been customary. If the reader is prepared to take the mathematics on trust, then certainly the tests he is asked to carry out, generally with the aid of tables, are not difficult.

(1) The pioneer textbook in the new form was R. A. Fisher's "Statistical Methods for Research Workers", in which not only was much new matter introduced to the consideration of teacher and student, but the method of presentation was also radically altered. Where difficulty has occurred, it has usually been due to an inability on the part of the reader to appreciate the subtleties of the argument, through ignorance of the theory on which it is based. On the whole, however, the biological worker is getting what he wants, and Tippett's "Methods of Statistics" is to be welcomed as another manual of statistics in the new style, which, within the compass of a little more than two hundred pages, covers a very great deal of ground.

There is little in the way of practical tests that does not find a place, and the book will repay careful reading. The numerous examples are welcome, but could with advantage have been treated in greater detail, at any rate at the

beginning; unless the reader fully understands the nature of every step in the calculation, which should be made clear by the actual working, and not solely by reference to formulæ, he is liable to be brought to a full stop. In fact, a general criticism is that the cloven hoof of the mathematician is occasionally allowed to obtrude itself, and the reader, while spared the proofs of the formulæ, is nevertheless assumed to be an adept at the equally difficult (to him) question of mathematical symbolism.

We welcome the further attempt to standardise a satisfactory notation, but terms are used which are still novel, and it is all the more necessary, therefore, to define them precisely, and avoid through looseness of statement any suggestion of giving a different shade of meaning to words already in use. In particular, the ideas of *population* and *sample*, and the distinction between population parameters and the estimates of these derived from a sample, have so recently emerged from an obscurity that was often deepened by the use of an insufficiently distinctive notation that the greatest care is necessary in elaborating these ideas.

(2) Mr. Brunt's book, the first edition of which appeared in 1917, is of a more heterogeneous character. It is described in the preface as a manual of least squares. The theory of errors of observations is developed along standard lines, and the details of the adjustment of observations by the method of least squares is very full. In a series of supplementary chapters, which alone have been revised in the new edition, some attempt is made on one hand to amplify the earlier treatment of the theory of error for the benefit of the biometrical worker, the subjects chosen being alternatives to the normal law of errors and correlation; on the other hand, an excellent account is given of harmonic analysis and the periodogram.

In contrast to Tippett, the book appeals to the mathematical reader, although in actual fact the mathematics is never very profound. The heterogeneity, evident from a description of the contents, is emphasised by an unfortunate change of notation when passing from the theory of error proper to the studies more appropriate to the biometrician, and by the separation of the chapters on least squares from the study of multiple correlation, when the latter, in fact, follows naturally from the former.

It may be doubted whether it is desirable in a book of the size and character of this to enter into details of the fitting of the Pearsonian or other forms of frequency curves. A general idea only of this development can be given, and the practical details of fitting are not entered into. While it is desirable to point out that not all populations are normal in character, it is also true to say that few experimenters have data so ample that significant departure from normality is found to exist. It is thus possible to find a self-contained textbook like that of Tippett in which the assumption of normality is implicit throughout. Brunt's textbook cannot claim to be a manual of statistics; at the best, only selected portions of the subject are dealt with, and the book as a whole is of a character that must be becoming increasingly difficult to write in this age of specialisation.

The early examples on the reduction of observations would have been improved by a discussion of tests of goodness of fit, while the chapter on correlation deals rather lamely, for a book of a mathematical character, with the formulæ for the probable errors of the various constants, which are introduced without proofs and with no discussion of their limited applicability in general to problems of this kind. The book is, however, clearly written throughout and there is little in it that is obscure. It should continue to be of service to the class of student to whom it is addressed.

J. Wishart.

Short Reviews

An Introduction to Organic Chemistry. By Prof. R. J. Williams. Second edition. Pp. xi + 585. (London: Chapman and Hall, Ltd., 1932.) 21*s.* net.

The publication of a second edition of this book four years after its first appearance, coupled with the fact that during those four years it was reprinted four times, is eloquent testimony to its popularity among both teachers and students of organic chemistry. This success must be attributed to the manner in which the author has presented most of the material, the result being a connected and well-written story in which many of the more recent advances of knowledge are incorporated.

In the main, the scope of the work conforms to its title, but the book differs from many of the smaller books on general organic chemistry in that considerable space is devoted to electronic formulæ and to a discussion on the structure of benzene. The predominant and most commendable features, however, are the lucid explanations of reactions and an array of graphic formulæ in support of the verbal explanations. At the same time the book stimulates thought, and the resourcefulness of the student in applying his knowledge is put to the test at the end of each chapter by means of a judicious selection of problems.

In general, the treatment is adequate, sound, and

up to date, but the section on heterocyclic compounds, including the chapter on alkaloids, must be amplified in a future edition if it is to satisfy the requirements of many of those students for whom the book has been written.

Le soleil. Par Prof. G. Bruhat. (Nouvelle Collection scientifique.) Pp. xii + 240 + 16 planches. (Paris : Félix Alcan, 1931.) 20 francs.

PROF. BRUHAT has used a course of lectures given at the Sorbonne in 1930 as the basis of this book, but has eliminated to a great extent the mathematical treatment of his subject in order to reach a wider circle of readers. All who possess an elementary knowledge of physical sciences will find the book an interesting, clear, and up-to-date account of the present state of our knowledge of the sun, as well as of the instruments and methods used in attaining that knowledge. A considerable amount of this matter is not to be found in any English works of a similar nature, but the historical accounts are occasionally inadequate or even definitely misleading.

Problems concerning the internal constitution of the sun or its evolutionary history receive little or no attention, as being beyond the scope of the book ; apart from this, however, recent advances in observational methods, results, and theories form a prominent feature, and the whole supplies a good introduction to modern solar physics. The printing and paper leave much to be desired, and an index would have been a useful addition to the book. The plates are suitably chosen as representative of the subject matter and well reproduced ; they are bound together at the end, and consist mainly of photographs taken at the Meudon Observatory.

A Manual of Determinative Mineralogy, with Tables : for the Determination of Minerals by means of 1. Their Physical Characters ; 2. Blowpipe and Chemical Properties ; 3. Optical Properties. By J. Volney Lewis. Fourth edition, revised by Prof. A. C. Hawkins. Pp. ix + 230. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1931.) 18*s*. net.

WITH the exception of certain minor alterations, the fourth edition of Prof. Lewis's well-known "Manual" differs but little from the third edition published in 1921. Prof. Hawkins, in his revision, has effected a very considerable saving in space, amounting to 68 pages, mainly in the physical tables. Instead of repetition in the case of such minerals as fall into two classes, an effective system of cross references has been employed. Further, in the tables of blowpipe reactions, certain rare and relatively unimportant species such as jarosite, glaucodot, etc., have been eliminated.

A short section has been added on optical properties, mainly with the object of impressing on the student the importance of optical properties in the determination of minerals. Optical data are given for a few common minerals. In its revised form, this work remains an exceedingly useful and simple guide to the determination of minerals according to their physical properties and blowpipe reactions.

Divorce : a Social Interpretation. By Prof. J. P. Lichtenberger. (Whittelsey House Publication.) Pp. xii + 472. (New York : McGraw-Hill Book Co., Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1931.) 21*s*. net.

THE use of scientific method and the disuse of appeals to authority, whether ecclesiastical or other, are the leading characteristics of this book. The author first states the problem, which is the explanation, not the justification, of the present divorce situation. He then enters upon a historical and descriptive account of marriage and divorce from the earliest to modern times, with special reference to America. Then, after considering some explanations of the divorce 'trend' which he regards as inadequate, he proceeds to develop his own lines of explanation. We think he begins badly by laying it down as an axiom that "divorce is an effect, not a cause", since the disintegration of the marriage has taken place before the divorce. But easy divorce is surely one cause of light views of marriage, and therefore of easy virtue. Yet there is so much excellent material in the book that it must be accounted a serious contribution. The author's wide knowledge of the literature of the subject makes him extremely apt in quotation.

A Naturalist in Brazil : the Flora and Fauna and the People of Brazil. By Prof. K. Guenther. Translated by Bernard Miall. Pp. 400 + 32 plates. (London : George Allen and Unwin, Ltd., 1931.) 25*s*. net.

THIS is an admirably illustrated book on the flora and fauna of Brazil. It marshals the natural history of the country in an instructive manner, but we do not discover that the author has concentrated on any special problem or added much to our previous knowledge. His chapters on "The Mosaic of Colours" and "The Symphony of Voices" are attractive, while the variety of devices employed by parents for ensuring the survival of their young will attract many readers. This is a book invaluable to anyone who desires to visualise the country and its inhabitants, a pleasant 'Baedeker' of Nature.

The Sciences of Man in the Making : an Orientation Book. By Edwin A. Kirkpatrick. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xv + 396. (London : Kegan Paul and Co., Ltd., 1932.) 15*s*. net.

IN the short compass of this volume, the author surveys the various sciences referring to man, from anthropology and ethnology to economics and politics, and from psychology to morals. No particular views are expressed, which belongs to the 'orientation' type now so popular in the United States. The 'suggested readings' at the end of each chapter refer almost entirely to American publications and authors. As a restatement of questions of methods relating to the study of mankind, however, the book makes enjoyable reading. T. G.

The Growing Tree *

By Prof. J. H. PRIESTLEY

RECENT studies of the growth of the tree, helped by some new methods, have shown that each season this growth begins in the bud, whence it spreads downwards over the rest of the tree. The discovery of this fact may influence, in quite a surprising way, our understanding of the tree—its form, its structure, and its vital functions.

LONGITUDINAL AND RADIAL GROWTH

The plants we call trees clearly have certain characteristics in common, though the botanist does not group them together in one class. They produce new crops of leaves periodically, but usually they do not flower for a number of years. Green leaves add to the substance of a plant, whilst flower and fruit exhaust it, so that the tree continues to gain in size and weight for many years. Much of this added weight is wood and bast, of which new increments are added each year, on the outer surface of the wood and the inner surface of the bast, by the activities of a growing tissue lying between wood and bast, called the cambium.

Each new crop of leaves is not borne directly upon the old wood but on new shoots which emerge from the buds. These new shoots grow in length, whilst the old branch system thickens but grows no more in length. The two growth processes do not seem connected at first sight, but the tree will only be understood when we realise that they depend very closely upon one another. During this year a new method of studying radial growth has been developed by which it has been possible to show how closely extension growth and radial growth are connected.

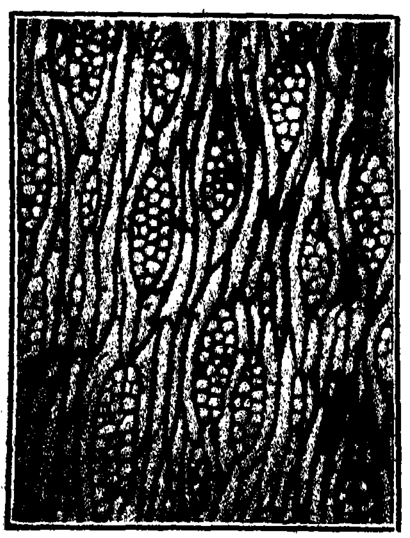

FIG. 1.—Photomicrograph of a strip of new tissue scraped from the surface of the old wood in ash. These cells have been formed by division of the cambial cells. × 100.

When the cambium recommences growth, its cells become very liquid, and the bark together with the bast easily peels from the wood, or, as we say, the bark 'slips'. The new soft plastic tissues can then be scraped off the hard old wood surface with a sharp tool, and long strips of tissues, newly formed from the cambium, can be obtained with the utmost ease. It has thus been possible to show that these tissues are first formed beneath the buds as they commence to grow, and that the cambial activity spreads thence always downwards—down the branches and down the trunk. These strips of tissue, as shown in Figs. 1, 2, and 3, exhibit beautifully under the microscope the structure of the new cells just formed from the cambium, and their study should reveal many new and interesting facts as to the changes these tissues undergo as they are transformed into wood.

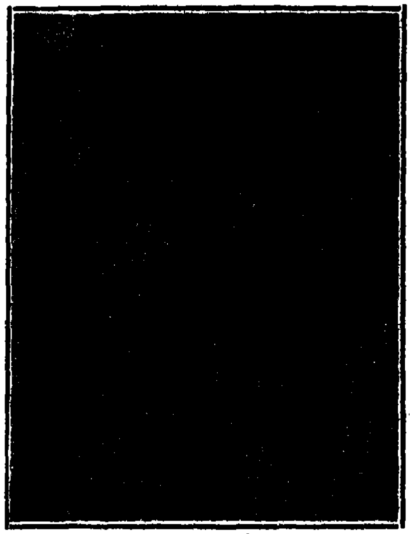

FIG. 2.—Photomicrograph of strip similar to that in Fig. 1, taken from spruce. Note the great length of the cells. × 133.

This new method has revealed most clearly the dependence of radial growth upon the buds. Cambial activity only begins after the buds commence growth, and cambium growth always spreads downwards from the base of the buds. We now know why, when pruning, the knife should cut across the stem just above a bud. Thus no piece of stem is left projecting above the topmost living bud. When such a piece of stem is left, the cambium in it never grows again, and this piece of stem withers to an unsightly snag.

The growth of buds depends very much upon light. The forester therefore plants his trees close together, so that the lower, side branches are shaded and their buds soon cease to grow. These branches then grow no more in thickness, lose their water, and become dry. On such withered branches the bark does not 'slip' but clings close, whilst on the main stem around their bases it is being pushed outwards by the growth of the cambium. The bark is thus thrust into sharp folds around the base of each withered branch, and the strain increases with continued growth until the dry branch is snapped off. Thus the lower dead branches are swept off, new wood still forms each year, and the stumps of these branches are gradually buried in the wood of the growing trunk, not to be seen again until they appear as knots in planks cut from the trunk. On the surface of the tree, the folds of bark may

* Substance of the presidential address to Section K (Botany) of the British Association at York on Sept. 5.

persist for many years, indicating the presence of these branch stumps, as the ripples on the pond tell of the stone sunk in its depths. The folds may be studied and recorded very simply, by placing paper over the bark and rubbing it with cobbler's heel-ball.

Softwood and Hardwood Trees

Branch systems, and the knots they leave in the timber, are rather different in two different tree types, the broad-leaved hardwood and the needle-leaved softwood. The former belong to the class of Dicotyledons, whilst the softwood belongs to the conifers.

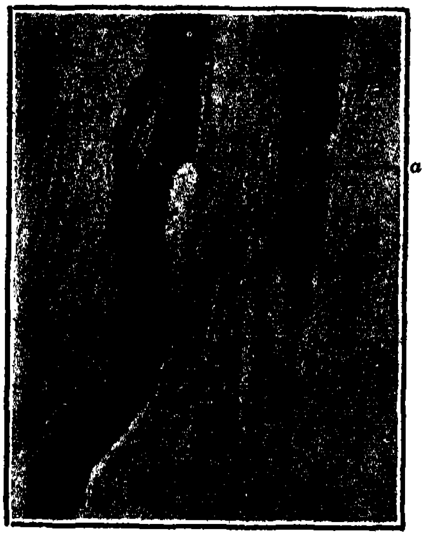

Fig. 3.—Photomicrograph of the new tissues, derived from the cambium in sycamore. Through the new tissues, are developing vessels (a) which are in communication with the leafy shoot above. ×100.

The softwoods have usually a very regular 'Christmas tree' habit of branching, a new whorl of branches appearing usually each year, and each spring as the buds begin to grow, radial growth begins and spreads downwards from the buds, but the lower and more shaded the branch, the slower the radial growth activity spreads down it. As a result, the cambium is growing actively on the main trunk, around the bases of the lower branches, before growth has begun on the branch bases themselves. The old wood of the branch is thus gripped in the new wood of the trunk which forms around it but is not in actual union with it. Only later, as the cambium on the branch also begins to grow, do branch and main axis join in forming one common sheet of wood. In a thin softwood plank, therefore, the wood of the branch may lie loose in the wood of the trunk and, if the wood of the main stem rots away, the tapering ends of the whorl of branches may often be seen projecting inwards into the hollow trunk (Fig. 4).

In the hardwood, branches do not arise in so regular a manner, or so many at one level, but when growth begins, the branch base and the main axis at the same level commence growth at almost the same time. Main stems and branch therefore join in forming a common layer of wood from the outset, and thus the knot, even in a thin plank, will be firm. This continuity of wood from the branch to the main axis is clearly shown in Fig. 4.

In both poplar and oak in Great Britain, branches that do not make good growth tend to be cut off before they wither, by a natural process of abscission (see Fig. 5). This happens especially with flowering branches of the Canadian black poplar, and each summer the ground beneath trees that have commenced to flower is carpeted with branches with smooth expanded bases which have fallen from the trees, while saucer-shaped scars are left on the branches from which they have fallen.

In the softwood, the living cells of the cambium are like very long, thin threads. Each thread grows in size and then cuts itself lengthwise into two equally thin threads, of which the inner one will in time become a new wood element, as seen in Fig. 2. In the process it will absorb much water, its wall will thicken and lignify, its living contents will disappear, and it will thus become a fibre or tracheid. All these fibres are of much the same size, a few millimetres long, and they all expand about the same amount during development, more in the early part of the season, when they form the thin-walled spring wood, less later on when they form the summer wood, so that each year's ring of wood is thus recognisable as an annual ring. As all the developing tracheids, cut off from the cambium at the same time, do the same thing, to the same extent, in about the same period of time, the wood is very regular and composed entirely of similar fibres. When these developing tissues were scraped off the old wood in June, a fine spray shot into the air to a height of more than a foot, so that the liquid in these minute developing tracheids must have been held under great pressure. It is this pressure, squeezing the soft cambium cells out against the inside of the bark, which probably

Fig. 4.—On left, a branch union in a hardwood (Large-leaf maple), showing clearly the continuity of wood from branch to main axis. In the centre (Grand fir) and on the right (Douglas fir) are cross sections of softwoods, in which the inner wood of the main stem has rotted away, leaving the tapering ends of the wood of branches projecting into the hollow cavity. The branch of the Grand fir, in the centre, was growing horizontally and has formed more wood on the lower side. (Photograph by Mr. Pemberton, British Columbia.)

accounts for their curious shape. The more vigorous the growth of the tree, the longer these thin flattened threads of cambium cells become.

In the hardwood, on the other hand, the cambium cells are much shorter, smaller cells, and cut off cells like themselves towards the wood, which later may take in water and expand. But these short cells have transverse walls at the top and the bottom, which collapse under the strain, so that the contents of the cells coalesce. This happens to certain vertical series of cells over long distances

in a very short time, so that a long row of such tiny cells expand very considerably in width and coalesce end to end to form a vessel which may be many feet in length and more than a tenth of a millimetre in diameter, as shown in Fig. 3. The formation of this vessel, like cambial activity, begins beneath the bud and spreads thence very rapidly downwards. It follows that, at lower levels, the cell which lies just in the line of such a vessel is expanding with water before its neighbours which were formed at the same time, and its expansion takes place at their expense. The vessel segment expands relatively greatly, whilst the other cells are squeezed and elongated. These longer cells, when later their walls thicken, become the fibres. Thus the hardwood, in contrast to the softwood, has a diversified wood structure, with vessels interspersed amongst elongated narrow fibres, whilst the swelling of the vessels is not accompanied by a great pressure against the cambium, the cells of which remain relatively short.

FIG. 5.—Twigs of oak, fallen whilst still living by a process of natural abscission. The swollen scars are shown clearly. About ½ natural size.

WATER SUPPLY TO OPENING BUDS

These characteristic growth processes in the tree have a direct bearing upon such a problem as the movement of water in the tree. The water enters at the roots, and great forces are needed to carry it to the tops of trees which may be more than 300 feet high. It moves in the wood, in the tracheids of the softwood or the vessels of the hardwood, and it is usually assumed to-day that it is driven upwards by forces in the root and pulled by forces at work in the leaves from which water is evaporating. But we have seen that if a bud does not grow, both the bud and the twig beneath it lose water, so that the growth of the bud seems to attract water into it. Water is necessary for the growth of the bud, and an old experiment seems to throw light upon the entry of water into the bud in spring. If a cut branch is warmed in spring, water can be seen to well from the wood at both cut ends. In the uncut branch on the tree, the same movement of water will take place as the temperature rises, but now, from the way the wood has been formed, all this water will find its way into the buds, where the ends of the most recently formed wood elements are to be found. Then the bud begins to grow, and growth spreads downwards through the cambium beneath the bud.

It can be shown that both these growth processes attract water out of the old wood by osmotic forces developed in these growing tissues. Water movement in wood can be shown to take place under the operation of such forces, and the conditions to develop such forces can be demonstrated in the developing tissues. When new wood develops beneath an expanding bud, down over the surface of the old wood, water is moved from the old wood, which thus acts as a reservoir, into a new system of pipes the terminus of which is to be found in the elongating shoot with its new leaves. It is evident that this is the way in which the new shoot obtains its water, and that this is the explanation why a branch that does not grow loses its water to the growing parts of the tree. This gives us quite a new picture of water movement in the tree, which is no longer seen as a movement along one set of pipes, either pushed from below or pulled from above in direct continuity with the new shoots.

WATER SUPPLY TO THE EXPANDED FOLIAGE

During the winter, when water still enters the roots and the shoot system is not growing, the supply of water in the old wood is increased; but immediately growth begins in spring, water is drawn from the old wood into the new tissues, and a simple type of experiment shows that it is withdrawn more quickly than it is replaced. When the wood is cut open under a coloured liquid such as Indian ink, no ink enters the newly developing vessels, which are obviously full of liquid, but it rushes into some of the old wood lying just beneath these new tissues, thus showing that their contents are in a condition of tension. In early summer, when the leaves are expanded, the ink will also enter the first formed of the new wood elements, the contents of which must also now be under tension. This experiment is most striking if carried out in June with the ash, when the long vessels lie just below the surface of the cambium and are visible to the naked eye. When they are cut open under Indian ink, the ink shoots both upwards and downwards at a rate which often exceeds 20 ft. a minute, and thus travels to a distance of many feet from the place of injection. The ink will not pass the cross walls which close the vessels at intervals, but lead nitrate will do so, and can be shown to travel in a few minutes down into the roots and up into the leafy shoots. The experiment has a very practical side, because it shows how soluble poisons may be successfully used to kill a tree. This is sometimes a real need, as in tropical Africa at present, where control of the movement of the tsetse fly is being attempted by completely clearing belts of country of vegetation.

It is usually assumed to-day that when the contents of the wood are in a tensile condition, the wood contains liquid sap at relatively high ten-

sions. This view is difficult to reconcile with the rapid entry of the injecting fluids, and the result of further injection experiments is to suggest that many wood elements in tension contain water vapour. Such elements, when water is available, will readily fill with water again. These observations do not solve the problem of the ascent of sap in tall trees, but they do suggest it is ripe for reconsideration. They also remind us that the buds and branches at a great height always obtain their water by a machinery that is only set in motion by their own growth.

Similarly it may be pointed out that the downward movement of food in the tree—a movement that is usually associated with the bast—seems to be linked with the growth of the bast. This tissue is also formed from the cambium, its formation beginning in the leaf, whence the process spreads gradually down the branches to the trunk and the roots; and the spread of this process of growth synchronises with the time at which a gain of dry weight takes place in the lower regions of the tree. If an attempt is made to estimate the amount of transfer of substance involved in the formation of the new tissues from the cambium, this downward-progressing growth process evidently largely accounts for the movement of substance that takes place. It is clearly impossible to dissociate the problem of transport in the tree from the processes of growth.

Measurements of Solar Radiation *

THE work of the Smithsonian Institution's Astrophysical Observatory during the decade 1920–30 is described in vol. 5 of its *Annals*, recently published after an interval of ten years since the appearance of the preceding volume. To assist the reader in forming a proper perspective view of the work, the volume is prefaced by a brief description of the long research on solar radiation undertaken by the Observatory, first under Langley, and later under Dr. C. G. Abbot. It forms an impressive account of a great investigation, of fundamental importance to meteorology, in which the Smithsonian Institution has been the pioneer and practically the sole worker. The latter is to be regretted, since it is desirable to have independent determinations of so important a quantity as the sun's radiation. There is fortunately no doubt, however, as to the substantial accuracy of the mean Smithsonian value of the 'solar constant'.

One decisive result has emerged from the work of the Observatory, as a consequence of gradual improvements both in the instruments and methods of observation, and in the understanding and reduction of the measurements. It is that the sun's radiation, as it reaches the outside of the earth's atmosphere, and after correction to the mean distance of the earth from the sun, *is* constant within very narrow limits. At earlier stages of the work the Smithsonian view was contrary to this; it was contended that the observations showed variability over a range often exceeding five per cent; the supposed variations ranged over several per cent in the course of years, and showed correlation with the sunspot period; there were also variations over short periods of a few days, which were believed to be confirmed by independent observations for more than fifty days at Bassour in Algeria and Mount Wilson in California. Important consequences for terrestrial weather and weather forecasting were inferred from these results.

In the present volume an account is given of the establishment and progress of several solar radiation observatories, located on mountain tops in desert lands, at which a daily record of the sun's radiation is attempted, both as received at ground level, and as inferred after allowing for atmospheric absorption. The conclusion is reached that "the earlier impression [of considerable solar variations] is not supported". "We incline to think that the earlier impressions of a larger solar variability were founded on measurements too much affected by terrestrial atmospheric influences. A residuum of apparent solar variation remains, nevertheless, after making all possible improvements. Comparison of results of remote stations; correlations with other measurements independently made by other observers; and especially correlations with weather changes at remote stations, all incline us to consider present indications of solar variation as largely real" (p. 5). The average deviation of the solar constant as measured at a single station on a single day is given (p. 244) as 0·29 per cent, the probable error being 0·24 per cent, as derived by comparing the measurements of the best station (Montezuma, Chile) with those made at Table Mountain (1926–30).

These changes are very small, and in view of the great difficulties involved in correcting accurately for atmospheric absorption, a proof of real solar variability must, as is stated, be very difficult. Comparison of the variations recorded at Montezuma and Table Mountain, in cases where satisfactory daily observations occurred consecutively at both stations simultaneously over intervals of ten days or longer, is thought, on the whole, to show a great similarity in the march of the curves, though there are instances of great dissimilarity. But it is pointed out that in these intervals solar changes exceeding 1·5 per cent are rarely indicated.

My own impression, after reflecting on the observational difficulties, the possibility of accidental agreements between the changes at different stations, and the past history of the research, is that the reality of these small variations is not proved. To establish them, much better evidence is required in the form of long-continued observations at different stations, and also independent determinations by different methods at the same station. The correlations with other measurements, and especially with weather changes, which

* Annals of the Astrophysical Observatory of the Smithsonian Institution. Vol. 5 (Pub. No. 3121). By C. G. Abbot, L. B. Aldrich, and F. E. Fowle. Pp. ix+295+11 plates. (Washington: Government Printing Office.)

are mentioned as accessory evidence in the above quotation, seem beside the point; indeed, they prompt doubts as to the soundness of the discussion and interpretation of the data, doubts which are strengthened by the description of the methods used for determining alleged periodicities in the small observed variations of the solar constant. This part of the text is taken substantially from Dr. Abbot's paper of 1931, entitled "Weather Dominated by Solar Changes", the main thesis of which has not carried conviction with most meteorologists. On this point, I am in agreement with Dr. Kimball, who, in the *Monthly Weather Review* (Dec. 1931, p. 479), wrote, "Is it rational to believe that these major weather changes are caused and explained by alleged short-period changes of less than 1 per cent on the intensity of solar radiation? A part, if not all, of this 1 per cent variation must be set off as caused by inevitable accidental errors, but even if the whole of it were real solar change, can we believe that if this small variation were to cease our major weather changes would disappear also?"

I would regret, however, to end this review on a critical note. The answer to doubts as to the solar variations will be afforded by observations which the Astrophysical Observatory is continuing, and by others for which it makes an earnest plea. While Dr. Abbot states that even the best present data, from Montezuma, fall just short of the accuracy that is required, he adds that there is good hope of making several improvements which should appreciably diminish the experimental error at all the stations.

Besides the main work relating to daily observations of the solar constant, the volume includes an account of the study of the distribution of radiation in the solar spectrum, particularly in the ultra-violet and infra-red regions not covered by the daily solar observations. One interesting and unlooked-for result of the Smithsonian work was the determination of the ozone content of the atmosphere above certain stations, from the yellow-green atmospheric transmission coefficients.

S. CHAPMAN.

A Bibliography of Boyle

'BIBLIOGRAPHY' is a word which has many meanings. The merely enumerative cataloguing of books is the least; their discrete anatomies a higher; and highest of all is their comparative anatomy, working on from detailed observation through steps of induction and verification as rigidly and delightfully scientific as any man of science could desire. But the aims of those who practise in these loftier realms are not always single. On one hand, the pure bibliographer has for his aim the discovery of bygone methods in the various crafts of book-making; to him the matter in the volumes which he studies is no more than the 'copy' supplied to a compositor, and the mind of the author—except inasmuch as its vagaries may cause disturbances in proof, and produce variant issues—exists as a remote First Cause, beyond inquiry. How much of the archæology of the greatest art in civilisation has been discovered by such students is recognised only vaguely, even by some of the historians who might make use of it. The literary bibliographer, on the other hand, has a different aim; his primary interest in a series of books is in their author (or a group of authors); yet even he wins little enough sympathy from most of us, who are content with the innocent rôle of gentle reader.

It will be seen that the bibliographer is a lonely soul as a rule; and if he strays beyond the warmth of his own circle, the wind of the world blows past him chilly and comfortless. No wonder that he and his kind have hitherto purposely shunned contact with students of the impersonal arts of Nature, who outside *their* circle are supposed to be inhumanly heedless of persons and the past, and regardful only of things and the present. There have been, nevertheless, bibliographies (in the full sense) of scientific work: usually, however, according to subjects—such as Mr. James Henderson's "Bibliotheca Taqularum Mathematicarum"—or of a library, such as Ferguson's well-known work on the Young chemical collection. Of bibliographies of single scientific authors there must hitherto have been very few that would satisfy bookmen as well as men of science. However, the collector's enthusiasm of the late Sir William Osler for medical works set a vogue in this field, and so it was not surprising that William Harvey was the subject of the first true bibliography of a seventeenth century scientific worker, produced a few years ago by Mr. G. L. Keynes. Now a kindred interest has inspired Prof. J. F. Fulton, lately fellow of Magdalen College, Oxford, and now professor in the School of Medicine at Yale, to undertake a larger and very difficult task: the bibliography of Robert Boyle.*

Let it be said at once that Prof. Fulton has carried out the task with particular success, happily conjoining the functions of both types of bibliographer. He has not only used the resources of a score or so of great libraries in Great Britain and on the Continent, but he has also achieved the rare privilege of being himself the owner of at least one copy of very nearly every work, edition, issue, and variant that comes within the wide scope of his title. The unrestricted opportunities for close examination and repeated reading which this has given him show, by their results in this volume, the honourable side of book-collecting; and the scientific historian (or, more probably, the group of them) who may some day try to set before us Boyle's contributions to knowledge, will be deeply in Prof. Fulton's debt.

In Section A are described forty-two distinct and self-contained works by Boyle, first printed between

* *Proceedings and Papers of the Oxford Bibliographical Society*, vol. 3, pt. 1, pp. 1-172. "A Bibliography of the Honourable Robert Boyle, Fellow of the Royal Society", by J. F. Fulton. (Oxford: University Press.) 10s.

1659 and 1695, and afterwards in editions and issues described to the number of about two hundred. This constitutes the most important part of the bibliography. In Section B are cited forty contributions by Boyle to other works, including thirty-five papers printed by the secretary of the Royal Society in the *Philosophical Transactions*. A third section shows the editions of Boyle's collected works, including the separate theological collections; there follow ten examples of book-dedications to him, contemporary and later; ten elegies and funeral sermons; and notices of about a hundred and seventy biographies and commentaries on Boyle. An appendix contains a list of the Boyle's Lecture sermons and their preachers from 1692 to 1929, and a list of the Robert Boyle lectures which have been given at Oxford for the last forty years. The frontispiece shows the attractive bust of Boyle by Rysbrack, discovered lately at Kensington Palace by Mrs. Esdaile; and there are twenty-two facsimile reproductions of title-pages and other matter. Prof. Fulton's preface is pleasant and useful, and there is a full index.

Each separate work is introduced by a short account of its bearing upon Boyle's life and upon the parts of science which it touches together with notes of general bibliographical interest. For each volume described, there are given the full title, with indications of the types used; the collation; any sub-title; notes of relationship to other issues; any special points; and a list of places where copies exist. As to the thoroughness of the book-anatomy, the reviewer can only say that he had a few small discoveries in this field which he thought were his own—but they are all here, and many more, and his chagrin as a censor is replaced by pleasure as a pupil. Prof. Fulton's assessments of Boyle's works do not profess to be more than finger-posts, and ultimately the hoped-for scientific historian of Boyle might here and there dissent from a judgment. But, subject to this merely occasional reflection, Prof. Fulton's prefaces really add to the worth and interest of the book.

The Oxford Bibliographical Society is to be congratulated on having produced as part of its *Proceedings* a handsome bibliography which is not only new in theme and long-wanted, but also as nearly final and complete as even, perhaps, its author could desire. To his modest terminal quotation from one of Boyle's prefaces, disclaiming the world's applause, one may be allowed to reply with one from another author; Dr. Fulton's is a work "In which, though to the blind and common crowde (to whom all thats unusuall is a paradox) there may perhapps appeare what they'll dare call extravagant, and to the midle-cyzed gymnastickes what they'll conceive ill grownded though ingenious guesses, yet surely will the more solide reflections of all knowing men begette a liking of its acquaintance". Irvine Masson.

Amalgamation of the Physical and Optical Societies

After full consideration of the scientific, legal, financial, and political questions involved, a scheme for the amalgamation of the Physical Society of London and the Optical Society has been drawn up and unanimously recommended by a Committee representative of the two Societies. The process is now complete, and a new society, the Physical Society, has come into existence.

In pressing forward the scheme to completion, the Councils of these Societies were gratified to find that they had the support of an overwhelming majority of the members of both Societies, who fully realised that, despite the grave nature of the change involved, the advantages attendant thereon completely justified the action of the Councils.

It must be understood that the scheme is, as it states, an amalgamation—a fusion of the Societies concerned. The preservation of the name of a society is a matter which has, at best, a sentimental value; the conservation and widening of the advantages of membership is the material concern. In making a balanced estimate of the advantages accruing from such a fusion, it must be remembered that the circumstances in which the Optical Society was founded are scarcely germane to the present situation. However specialised its aims may have been in the earliest years of its existence, the Optical Society, as a glance at its *Transactions* will show, has developed into a general scientific body with an outlook scarcely to be distinguished from that of the Physical Society of London.

Thirty or forty years ago, in the homely days of the Victorian era, there was room, and need, for small semi-private societies, the members of which might meet and discuss in a familiar and intimate way problems of fundamental interest in their science and profession. Matters are changed nowadays. Physical science is playing a part in the fashioning of national character and the fostering of national well-being which was undreamt of a generation ago: scientific bodies are in far closer touch with the organised activities of the community than they have ever been in the past, and unnecessary divisions and separations are to be deprecated, inasmuch as they inevitably weaken the weight of any appeal which may be made by the societies in the name of physical science. There is no question that the prestige and authority of the Society which has risen from the union of the two Societies will far exceed that of the individual Societies considered as separate units.

The amazing growth of physical science during the past generation has inevitably produced much specialism. So far from taking all knowledge for his province, the scientific man of to-day is fortunate if he can cultivate with a measure of success some one corner of one of the sciences. Nevertheless, the repercussions of physical science in general on that single division are so numerous and so important that the neglect of their study unduly hampers the serious student. It has been an important part of the business of the Physical Society of London to make possible a critical study of these repercussions; the lectures and discussions which

have been held, and the reports which have been published under its auspices, the issue of *Science Abstracts*, the fortnightly meetings in London which resulted in the reading and annual publication of some fifty papers concerned with all branches of physical science, the annual provincial meeting—all these activities have helped to provide a background for the specialist worker in physics such as could be obtained by membership of no other British society. And, as is shown by their membership of the Physical Society of London, many fellows of the Optical Society have not been slow to recognise these advantages.

In some quarters a fear has been expressed that the fusion of the two Societies will leave workers in applied optics without a forum in which to express their views. Nothing could be farther from the truth. Optical science is no longer confined to a narrow sphere of influence but has become the handmaid of all sciences, and optical instruments are now tools of industry. The amalgamation now completed is a visible sign of the union, to their mutual benefit, of the most representative body of producers of optical methods and instruments with the body which represents the largest and most important group of users of such methods and instruments. Under the auspices of the new Physical Society, the Guthrie lecture and the Thomas Young oration will be delivered as heretofore; papers on optical subjects have been a prominent feature in the *Proceedings of the Physical Society of London*, and their number will be materially increased under the new regime; arrangements for special lectures on topics of optical interest have been made, and the session now opening will be inaugurated by a lecture by Dr. J. W. French on "The Manufacture of Optical Glass"; and the probability of an increased output of papers is provided for by an increase of one part per annum in the number of published parts of the *Proceedings*.

The Councils of the Societies have no regrets in carrying out this amalgamation. They believe that it is, in brief, a plain commonsense measure fully in the spirit of the times and long overdue, and that its adoption will forward the interests of physical science and assist materially in the development of the science of optics.

Obituary

Mr. P. M. C. Kermode

MR. PHILIP MOORE CALLOW KERMODE, for many years the foremost authority on the antiquities of the Isle of Man, died on Sept. 5, at the age of seventy-seven years. The son of the Rev. W. Kermode of Ramsey, he was educated at King William's School, and was called to the Manx Bar in 1878. In the following year he founded the Isle of Man Natural History and Antiquarian Society, with the work of which he was closely identified for the remainder of his life.

Every aspect of Manx archæology and tradition held Mr. Kermode's interest, as was shown in the many contributions made by him to *Yn Lioar Manninagh*, the publication of the Antiquarian Society, of which he was editor. His authority was frequently invoked by the late Sir John Rhys, when dealing with Manx tradition and folklore; but his outstanding contribution to Manx archæology lies in his studies of the Celtic and Norse monuments of the island, and their inscriptions in runic and ogham, of which the results were embodied in "Manx Crosses" (1907), a standard authority, in which breadth of treatment and range of knowledge transcend local interest.

Among Mr. Kermode's more recent discoveries was that of an interesting Norse ship-burial, described last year, which revealed a ship of somewhat unusual type. In 1922, Mr. Kermode was appointed curator of the Manx Museum at Douglas, and in 1929 he received the honorary degree of M.A. from the University of Liverpool.

WE regret to announce the following deaths:

Mr. H. C. Chadwick, formerly curator of the Marine Biological Station, Port Erin, and afterwards research zoologist at the Station, and honorary lecturer in marine biology at the University of Liverpool, on Sept. 16, aged seventy-five years.

Dr. F. H. Hatch, O.B.E., technical adviser to the Mines Department, past-president of the Institution of Mining and Metallurgy, and author of several well-known textbooks on metalliferous mining, on Sept. 22, aged sixty-eight years.

News and Views

Nevil Maskelyne, 1732–1811

ON Oct. 6 occurs the bicentenary of the birth of Nevil Maskelyne—the worthy successor of Flamsteed, Halley, and Bradley—who for forty-six years held the office of Astronomer Royal and will always be remembered as the founder of the "Nautical Almanac". A man of mild and genial temper, Maskelyne was admirably fitted for the post he occupied so long, and at Greenwich steadily pursued the aims for which the Observatory was founded. Ever ready to acknowledge the work of others and to further the interests of science, he gained the esteem of all who knew him, and when, after his laborious experiments on the slopes of Schiehallion, Perthshire, made to determine the density of the earth, he was awarded the Copley Medal of the Royal Society, Sir John Pringle in addressing him said that the Council presented him with the medal not only as a token of their acknowledgment of his work but as a "sincere pledge of their affection".

Maskelyne was born in London on Oct. 6, 1732, being the son of Edmund Maskelyne of Purton, Wiltshire. At the age of nine years he was sent to Westminster School, and it is said that, like Lalande and Messier, he was attracted to the study of astronomy by the solar eclipse of 1748. From Westminster School he proceeded to Cambridge, entering first Catherine Hall and then Trinity College, graduating as seventh wrangler in 1754. The following year he took holy orders and was appointed to a curacy at Barnet. He next took the degree of M.A., was made a fellow of Trinity, and in 1758 became a fellow of the Royal Society, his first paper to the Society being written in 1760. Already known to Bradley, in 1761 Maskelyne was sent to St. Helena to observe the transit of Venus in order to determine the parallax of the sun, and two years later sailed as chaplain of the *Princess Louisa* on a voyage to Barbadoes, during which he tested the accuracy of Harrison's chronometer. The death of Bliss in 1765 leaving the office of Astronomer Royal vacant, Maskelyne was appointed to it. He had already in 1763 published the "British Mariner's Guide", and he was now able to prevail upon the Government to issue that eminently useful work the "Nautical Almanac". The almanac for 1767 was published in 1766, and for the succeeding forty-five years subsequent editions were superintended by Maskelyne. In connexion with his constant efforts to improve navigation, he edited the important lunar tables of the German astronomer Tobias Mayer (1723–1762); and obtained for Mayer's widow a grant of £3000, and for Euler, whose lunar theory he used, a grant of £300. Though in early life Maskelyne became a clergyman and afterwards received the degree of D.D., and was given the livings of Shrawardine, Shropshire, and North Runcton, Norfolk, most of his time was spent at Greenwich Observatory, and it was there he died on Feb. 9, 1811.

International Congress of the History of Medicine

The ninth International Congress of the History of Medicine was held at Bucharest on Sept. 10–18, under the presidency of Dr. Victor Gomoiu, with King Carol II., who opened the Congress in state, as president of honour. Two principal subjects were chosen for discussion, namely, the evolution of medicine in the Balkan States, on which papers were read by representatives from Albania, Bulgaria, Czechoslovakia, Greece, Rumania, and Turkey, and the defence of Europe against plague, to which subject the chief contributions were made by Prof. Ricardo Jorge, director of public health at Lisbon; Prof. J. Guiart of Lyons, Prof. P. Capparoni of Rome, Prof. D. Giordano of Venice, Prof. G. Sticker of Würzburg, and Prof. L. Zembruski of Warsaw.

In addition, a number of miscellaneous papers were presented, including the history of medicine and scientific criticism by Prof. A. Castiglioni of Padua, the development of operative gynæcology by Dr. I. Fischer of Vienna, the history of spectacles by Prof. W. Reis of Lemburg, Polydore Vergil by Prof. J. F. Fulton of Yale University, and Chaucer and medieval medicine by Dr. J. D. Rolleston, delegate of the British Government and the Royal Society of Medicine, who, like other national delegates, was elected honorary member of the Royal Rumanian Society of the History of Medicine and awarded the Rumanian Order of Cultural Merit (Class II.).

During the Congress visits were paid to the Faculty of Medicine, Prof. J. Cantacuzène's institute of serums and vaccines, Prof. M. Minovic's medico-legal institute, and various hospitals and museums, as well as to places of general interest. The last three days were spent in a motor tour through the country in the neighbourhood of Bucharest, with visits to sanatoria, the hospital at Sinaia, and the petroleum factory at Campina. A section of the Congress of the History of Sciences to be held next year at Warsaw will be devoted to the history of medicine, so that the next Congress of the International Society of the History of Medicine will not be held until 1935, when the meeting-place will probably be Madrid.

Aeroplane Height Record

On Sept. 16, Mr. C. F. Uwins, chief test pilot of the Bristol Aeroplane Company, Ltd., attained a height of 43,976 ft. (about 8⅓ miles) in a Vickers Vespa biplane, and on Sept. 23 this height was officially confirmed as the absolute height record. The engine used was a Bristol Pegasus nine-cylinder air-cooled radial, which is now in common use in Service machines. The engine develops 900 h.p., and for the purpose of the attempt on the height record was fitted with a larger supercharger than is fitted normally. Mr. Uwins felt very little personal inconvenience at the great height achieved. He wore electrically warmed clothing and also had an oxygen supply apparatus. The previous absolute height record was that set up by Lieut. Apollo Soucek of the United States Navy, who reached a height of 43,181 ft. on June 4, 1930.

Roman Road and Bridge, Rochdale

The repair of the bridge carrying the Roman road over the stream at Black Castle Clough, Blackstone Edge, having been completed (see Nature of Sept. 3, p. 340), the bridge was declared open by Sir Alfred Law on Aug. 20, when members of the Rochdale Literary and Scientific Society and a deputation of Halifax antiquarians were present. Some interesting particulars relating to the Roman road and the bridge were given by Mr. W. H. Crump of Leeds. It would appear that the Roman road, which served the traffic between Yorkshire, Rochdale, and Cheshire, fell into disuse in the year 1740 and had not been repaired since that date. Other old bridges in the neighbourhood are a packhorse bridge which was about ten feet wide, and another, eight feet wide, which carried the road to Oldham. The width of the bridge, now restored to its original seventeen feet, was far greater than anything required to carry the traffic of the district at any time since Roman days. The course of the packhorse road to Lydgate can still be seen on the adjacent hillside. In places it crosses the Roman road, in others it is some distance away. Its relation to the bridge can be seen from the fact that part of the pack-

horse road was destroyed in quarrying the material from which the bridge was built. The bridge now bears the inscription, "Restored 1932, J. H. Price", to commemorate the fact that the restoration was carried out on the initiative and under the supervision of Mr. Price. As previously mentioned, the workmen were volunteers from the unemployed, and material was given or lent by local contractors.

Undeciphered Scripts

According to a letter from Sir Denison Ross in the *Times* of Sept. 21, M. Guillaume Hevesy, a Hungarian resident in Paris, has discovered that a number of the signs of the prehistoric Indian script on seals from Mohenjo-daro also appear in the script of the Easter Island inscribed wooden tablets, while some of the Easter Island signs, not present on the Indian seals, are to be found in the proto-Elamic of Susa. It would now be interesting to hear whether there is any coincidence in the interpretation of the prehistoric Indian signs suggested by Sir Flinders Petrie (see Nature, Sept. 17, p. 429) and those suggested for the Easter Island script in the Report of the Committee of the Royal Anthropological Institute of which Mr. Sidney Ray was chairman. The suggestion of a connexion between the two scripts is not the only attempt to find an affinity between Easter Island and this part of Asia. M. J. Hackin, of the Musée Guimet, has recently directed attention to the resemblance which has been noted between the wooden statues, probably ancestral, which were objects of reverence among the Kafirs of Afghanistan before they were overwhelmed by Islam, of which examples are now preserved in the Kabul Museum, and the well-known statues of Easter Island. The resemblances certainly are strong, although it might be argued that they do not go beyond what may be due to the limitations of an undeveloped technique. It must also be admitted that when the material which it is sought to bring into relation is so widely separated in date as in these instances, the comparison, in default of intervening links, carries more interest than conviction.

The Development and Use of Talking Films

Every improved facility of communication has profoundly affected civilisation. The telegraph and the telephone and the widening of their scope by radio waves have benefited mankind. In the *Journal of the Franklin Institute* for August, H. M. Wilcox points out that the latest outcome of science, the talking film, has many useful applications for social and educational purposes which are not yet fully recognised. For example, a test was recently conducted at the Teachers College, Columbia University, to find the relative values of private study and seeing and hearing a talking film. Certain highly technical aspects of the training of teachers were presented by a talking film which lasted twenty minutes. Half of a group of students attended this, whilst the other half were given the monograph from which the film was constructed to study for half a day, but did not see the picture. A subsequent examination showed that the former group attained considerably higher marks than the latter. The author also lays stress on the fact that the talking film can democratise education in much the same way as it has democratised the dramatic stage. The great teacher can be taken to students in the most remote districts, and material presented to them which hitherto has been available only for the chosen few.

Mr. Wilcox also shows how highly technical are the problems of recording and reproducing sounds. Sound is judged by its pitch, volume, and quality (timbre). The pitch is measured by the frequency, the range being 16-16,000 cycles per second, and is frequently called the sound spectrum. The volume or loudness is measured in terms of energy intensity or pressure. Since the ear hears logarithmically, this is expressed in terms of logarithmic units called decibels. One decibel is approximately the smallest change in volume which the ear can detect. The quality depends on the presence of overtones, the frequency of which is an integral multiple of the fundamental tone. Male speech has a range of 100-250 cycles, and female speech, 200-500 cycles. Practically none of the characteristics of speech by which we recognise one articulate sound from another is particularly influenced by varying the fundamental. Early experience with talking films proved that, unlike silent films, the acoustic properties of the theatre itself had to be taken into account. This showed that both qualitative and quantitative acoustic measurements had to be made. This has led to the development of special instruments, the frequency analyser, the level analyser, the reverberation meter, and the noise meter, which are now successfully used for analysing the acoustic conditions in theatres, and in many other places as well. The success of the recent piano recital by Paderewski before an audience of 16,000 in Madison Square Garden without the use of any sound amplifying device shows what can be done by proper acoustic treatment.

The Swiss Broadcast Network

Practical experience seems to prove that radio transmission can only be utilised to its greatest advantage when wire connexions are used in part of the circuit. In the early days radio was a competitor with wire transmission, but now it co-operates with it, the co-operation being to their mutual advantage. The transmitting stations in a broadcast system are situated outside the cities where the studios are situated, and are connected to them by wires. In *Electrical Communication* for July, A. Muri, chief engineer of the postal administration at Bern, gives an interesting account of the Swiss broadcast network. For broadcasting purposes, Switzerland is divided into three zones. For French-speaking Switzerland, the main transmitter is at Sottens and is fed by the studios at Lausanne and Geneva. For German-speaking Switzerland, the main transmitter is at Beromünster and there are two relay transmitters at Bern and Basel. All three transmitters broadcast the same programme, and are fed from the studios at Zurich, Bern, and Basel as required. The main transmitter for Italian-speaking Switzerland is still under construction at Monte Ceneri. When completed it will be

served by the studio at Lugano. In order to meet the requirements for music transmission, circuits having a cut-off frequency of 10,000 are provided. This enables a sound spectrum of 35-7500 cycles per second to be obtained without distortion. In addition, there exist lightly loaded circuits having a cut-off frequency of 6800 cycles, giving a range of 150-5000 cycles for broadcast speech transmission. At present 87 per cent of all the toll circuits are in underground cable.

Broadcasting and Television in France

La Nature for Sept. 1 is devoted exclusively to an inquiry on television and broadcasting. The views of several eminent technicians both in France and other countries are given. Manfred von Ardenne takes an optimistic view of the progress of television in Germany and looks forward to a great increase in the art before next winter. Maps are given showing a national scheme for radio diffusion in France and comparing it with the present system. A description is given of the new short-wave transmitter in Berlin, the largest in the world. Power of 15 kilowatts is emitted by waves seven metres long. It will help in the solution of certain problems in television and in producing broadcasting free from disturbance. The legal aspects of the problems which arise when a 'listener' is disturbed by induction from apparatus working in the neighbourhood are considered at length. Several law cases are quoted which show that the rights of listeners are recognised in France, and that those who use apparatus which interferes with the working of a private user's set are liable to substantial fines. The disturbances may be due to an electric motor driving a gramophone, neon tube lighting, the working of a cinema, the electric bell system on the ground floor, and public electric supply systems. In certain cases the use of devices to prevent interference is enforced. In conclusion, the influence of American improvements on the design of French receiving sets is discussed.

An Early Diffraction Grating

THE June issue of the *Journal of the Franklin Institute* contains two interesting letters from the second volume of the *Transactions of the American Philosophical Society* (1786), from which it would appear that a transmission grating had been used to produce spectra prior to the work of Fraunhofer (1820). The first, which is addressed to David Rittenhouse from F. Hopkinson, of Philadelphia, has a description of the appearance presented when a street lamp is viewed through a silk handkerchief, and contains a request for an explanation of the pattern formed. The second, dated eleven months later, is Rittenhouse's reply. From its contents, and the lapse of time from the first letter, it appears that he had given considerable thought to the matter. Starting with the observation that the experiment is more curious than one would at first imagine, Rittenhouse then describes the grating he made to perform it with more accuracy. He constructed a square of parallel hairs, about half an inch each way, laid into the threads of two fine screws, with a pitch of 106 to the inch, which he had cut from brass wire. With this he observed a small opening in the window shutter in a dark room, at first with the unaided eye, and later with a prismatic telescope and micrometer, to measure the angular separation in units of the pattern. Six orders of diffraction were observed on either side of the zero, and measured up, and he noted that the dispersion of colours was in the opposite sense to that obtained with a prism, which he considered parallel to Newton's observations on the colours of fringes at the edges of shadows. Rittenhouse was unable to carry out the calculation of wave-lengths from his observations, as Fresnel's theory of diffraction did not appear until 1815, but his data lead to quite good results: 6200 A. for the red, and 4600 A. for the blue. He does not appear to have followed the work up further, so far as this correspondence goes. Fraunhofer's work was of course the more complete, but this experiment is interesting as coming in the gap between the time of Newton and that of the great optical researches of the early nineteenth century.

Hydro-electric Power on the Dnieper

A REPORT from Washington states that "Dneprostroy" was dedicated on Aug. 25. This hydro-electric power project on the Dnieper River, with a capacity of 756,000 h.p., is the largest in the world. The power will be available for metallurgical and chemical industries and to irrigate the rich but droughty steppes. Ships from the Black Sea will now be able to penetrate hundreds of miles farther inland. The cost is approximately 110,000,000 dollars, and the dam, the largest ever constructed, was constructed ahead of the schedule. The dam is 3350 feet long and 140 feet high to the crest of the spillway, above which water may rise 30 feet during floods. The structure impounds a flow varying from 6300 to 835,000 cu. ft. a second at times of large freshets. Six of the nine power units are now being installed. The turbines have a rated capacity of 84,000 h.p., and 100,000 h.p. under a maximum head of water. The maximum or high-water capacity is 900,000 h.p., but owing to irregular flow, only three of the units can be operated during the entire year.

Agriculture in the East of England

THE report on an "Economic Survey of Agriculture in the Eastern Counties of England" issued by the Department of Agriculture, University of Cambridge, and published by Messrs. Heffer and Sons, Cambridge, price 2*s*. 9*d*. post paid, presents an analysis of the financial results for 1931 of nearly a thousand farms in the province. During the year farmers in this area experienced heavy losses. The general price level of agricultural produce averaged 18 per cent below that necessary to provide occupiers with a reasonable return for their own labour and capital investment. The majority of those farmers who were fortunate enough to secure a profit enjoyed special marketing facilities, retailed milk or concentrated on the production of livestock and livestock products, or both. As the eastern counties are generally described as a grain-growing area, it is rather surprising to find that while sales of cereals amounted to less than 14 per cent of the gross income, sales of livestock and their products

represented nearly 70 per cent. The very low prices obtainable for the 1931 cereal crops influence these proportions, but even taking this into consideration, cereals can be described as an important cash product on the larger farms only. The success of the small farmer, and these form the majority, is more dependent on the price of livestock and feeding stuffs than on those of cereals. Interesting comparisons are made of the organisation of the agriculture of the principal farming localities of the province: for example, central Norfolk light loams, the Norfolk 'breck', central Suffolk heavy soils, south Essex London clays, south Cambridgeshire gravels, etc. The most depressed areas are the boulder clays of Essex and Suffolk, and the clays in west Cambridgeshire and Huntingdonshire. The report deals further with main factors influencing profits and with many other subjects of interest to administrators and to farmers.

Electricity and the Farmer

A PAPER read by F. E. Rowland at the Royal Agricultural Show, Southampton, on July 7 and printed by the B.E.D.A. (British Electrical Development Association, Inc.) of 15 Savoy Street, W.C.2, gives helpful hints to farmers as to the best way to apply electricity to their farms. The price of the unit is taken as 2*d*., and when it can be obtained at this price a good case is made out for using electric power. In many cases when space is limited, as in stackyards, electric drive has many advantages. 18 sheep can be sheared per unit expended, or 45 horses groomed, or 12 horses clipped. Motors can be rolled from one part of a farm to another inside wooden drums. Excellent and economical methods are given of lighting farm buildings and roads. Electrically driven pumps provide automatically a plentiful supply of water for all purposes. The use of electric milkers which require a $\frac{1}{2}$-h.p. motor is becoming widespread in England. In New Zealand 15,000 are in use. By the expenditure of one electric unit, 22 cows can be milked, 120 lb. of butter churned, or 1000 bottles washed. Accurate data are given as to the effect of poultry lighting in stimulating egg production.

A New Journal of Animal Ecology

IT is gratifying to find that zoological analysis, having for long been largely confined to the laboratory, is being pushed with vigour into the open country, the obvious place for testing and resolving some of the big problems of animal life. So insistent has been the demand for space to publish the results of observations upon animal populations, their distribution, fluctuations in numbers, migrations and the like, and to concentrate observations of the kind for the convenience of field-workers and zoologists in general, that the British Ecological Society has decided to issue, twice a year, a *Journal of Animal Ecology*, under the editorship of Charles Elton, assisted by A. D. Middleton. The first number, which appeared in May from the Cambridge University Press, is an attractive volume, in appearance as well as in matter. It contains many-sided contributions, from studies of the fluctuations of insect populations in wheat and of bird numbers on an Oxfordshire farm, to a rookery census, an analysis of the ranging habits of wood-ants, and an account of the biology of the fruit-bats of Australia. There are many illustrations, and a useful reference list contains summaries of papers dealing with animal ecology. Members of the British Ecological Society (Secretary, Dr. H. Godwin, Botany School, Cambridge) obtain the *Journal* for their subscription of 25*s*., to non-members the price is 30*s*. The magazine promises to make a niche of its own in British zoological literature, and the interest of its outlook ought to draw many supporters. We understand that so far as suitable material is concerned its success is assured.

Acta Phaenologica

THE new bi-monthly international journal *Acta Phaenologica* aims at concentrating the hitherto scattered studies in phenology and offering an opportunity to "set forth various tendencies, stages of development, points of view of different centres of phenological experiment, and by giving a chance to consult on aims and methods, to achieve useful and active collaboration". The journal is issued under the editorship of the board of the Phenological Association of the Netherlands, and in the first part (Sept. 1931: Publ. Martinus Nijhoff, The Hague) the Secretary, Dr. H. Bos, writes on the scope and prospects of phenology. In the same number there are articles by J. Edmund Clarke on "The Cold Spring of 1929 in the British Isles" and S. Illichevsky on "The Results of the Phenological Observations at Poltava (U.S.S.R.)". The second part includes contributions from Prof. Ihne on "The Beginning of the Phenological Spring in Central Europe during the Ten Years' Period, 1921–1930", Prof. Poggenpohl on "Phenological Observations, 1886–1907", and Dr. H. Bos on "The Dropping of Small Fruits after Blooming". Contributions are accepted in English, French, or German, and each is accompanied by a translation of its title and a short summary of the contents in the two other languages.

Habits of the Woodpecker

ALTHOUGH a tame woodpecker is mentioned by Aristotle, the birds of this family have never been favourites with aviarists, and even the London Zoological Society, after having exhibited at different times no less than seventeen species, had been without a specimen for years until a family of the British greater spotted species arrived recently, and were accommodated with a special cage in the Bird House. Here they attract attention by their extreme activity, which is very characteristic of woodpeckers; they contrast in this respect with their nearest allies the barbets, of which several species are on view, much as tits do with finches. It is of interest to note, however, that the pair-toed feet, often supposed to be an adaptation for climbing, are to be found in the more primitive group of barbets, which do not climb, and that these peck wood when excavating a nest-hole, although their beaks are not specialised into the chisel-type of the woodpeckers' bills, and they do not

dig for food. Thus the woodpecking habit would seem to be older than the woodpecker; and that the pair-toed foot is not specially adapted for climbing is also shown in the fact that in several genera of woodpeckers the hallux or true hind-toe is absent or aborted, so that the foot ceases to be pair-toed.

Detecting Insect Pest Attacks

MR. A. M. MASSEE, of the East Malling Research Station, is to be congratulated on his simple methods for early detection of epidemics of certain insect pests of fruit trees (Ann. Rep. East Malling Research Sta., 1931, pp. 78-80). For example, attacks of caterpillar, aphis, or sucker can be detected if twigs from trees in various parts of the orchard are caused to produce growth early by placing them in water in a warm place. The growing spurs reveal the presence of pests which would not be recognisable in the ordinary way until the natural time of bud break. It is also possible to spray black currant bushes against big bud mite at the most effective moment, namely, just when the mites are migrating. A few affected branches are placed in a jar containing sand and water in the open; daily observation with a hand lens will show when the mites appear on the outsides of the buds, and so will also indicate when spraying should be performed. The idea will help materially to raise horticulture to the status of a more exact science.

Modern Milk Production

SUCCESS in dairy farming depends on the exercise of efficiency with economy in all departments of the industry. The main factors concerned in the cost of production are the milk-producing quality of the race and herd, the care given to breeding for milk production, housing, feeding, and general management. For the guidance of dairy herdsmen, the Ministry of Agriculture has issued a pamphlet (Bulletin No. 52, price 9*d*. net) in which all these factors are considered, and in which the most up-to-date methods of milk production are set forth clearly and in well-classified arrangement. The Ministry has had the advantage of the assistance of experts who have carried out extensive investigations into the many questions connected with the business of milk production, and it goes almost without saying that the result is an attractive as well as a highly practical guide.

A Serious Poultry Disease

THE Ministry of Agriculture and Fisheries issues a warning against the possibility of introducing the disease known as bacillary white diarrhœa into flocks by the purchase of infected chicks from hatcheries. Serious losses may be caused by such agency, the more to be regretted as a little preliminary precaution might have avoided the introduction of the disease altogether. It is conveyed to the chicks by infected hens through their eggs, so that it is of the utmost importance that the breeding stock should be free from the disease. Now, hens which are carriers of the disease may be recognised as such by the agglutination test, and eliminated from the breeding stock; so that a purchaser of eggs for hatching or day-old chicks should insist that the stock from which his supplies are obtained has been declared free of reacting birds. A number of county authorities for agricultural education now accredit poultry-breeding farms where the quality of the breeding stock reaches an approved standard, and where birds have been subjected to the agglutination test according to regulations laid down by the scheme.

Lecture Tours at the Natural History Museum

OWING to the success achieved by the appointment of guide-lecturers at the national museums and galleries, it has been decided to inaugurate more advanced lecture tours at the British Museum (Natural History), to be conducted by members of the scientific staff of the Museum, on Mondays at 12 noon, commencing on Oct. 3. It is announced that Miss M. R. J. Edwards has been appointed official guide-lecturer at the Museum in succession to the late Mr. J. H. Leonard, who died at the end of last year (see NATURE of Jan. 2, p. 15).

Announcements

MR. W. F. HIGGINS, principal assistant of the physics department of the National Physical Laboratory, has been appointed secretary of the Laboratory in succession to Mr. F. J. Selby, who recently retired.

MISS PENELOPE JENKIN, of Newnham College, Cambridge, has been appointed by the trustees as Ray Lankester investigator at the Marine Biological Laboratory, Plymouth, for the year 1933. Miss Jenkin will attempt to correlate the rate of photosynthesis of diatom cultures immersed at different depths in the sea, off Plymouth, with photoelectric measurements of light penetration made by Dr. W. R. G. Atkins.

A DEMONSTRATION of contraceptive technique will be given at the Clinic of the Society for Constructive Birth Control on Oct. 5, at 2.30-5 P.M., to medical practitioners and senior medical students only, who will be given an opportunity of practising various methods under tuition on women patients. Lectures and demonstrations will be conducted by Dr. Beddow Bayly and Dr. Evelyn Fisher and the midwife-in-charge. Applications for tickets (which are necessary) should be made to the Honorary Secretary of the Society, 108 Whitfield Street, W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An engineer in the Burma Marine Service—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Oct. 15). A Lawrence research student for research in some subject related to the cause and cure of disease in man and animals—The Assistant Secretary of the Royal Society, Burlington House, London, W.1 (Oct. 24). A professor of chemical technology at the University of Bombay—The Secretary, Universities Bureau of the British Empire, 88A Gower Street, London, W.C.1 (Nov. 7). An assistant to teach general mechanical engineering at the Darlington Technical College—Chief Education Officer, Education Office, Darlington.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Selective Transmission of γ-Radiation by Lead

SEVERAL workers have recorded an apparent anomaly in the γ-ray absorption of lead. Investigations carried out in this laboratory seem to throw new light on the phenomenon.

The mode of attack consisted in the continuous comparison of the γ-ray transmission through pairs of screens, lead and bismuth, lead and thallium, lead and copper, etc., when using as the source of radiation the ageing active deposit obtained in freshly filled radon

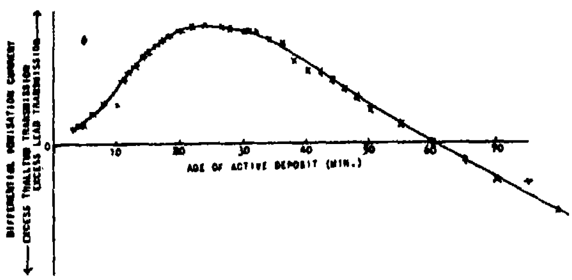

FIG. 1.—Selective γ-ray transmission from radium B through lead as compared with thallium. Source—80 m.c. radon. Screens—0·3 m.m. lead and 0·3 m.m. thallium.

containers. Comparisons carried out before the attainment of the transient equilibrium between radium *B* and *C* show that the transmission ratios Pb/Bi Pb/Tl gradually increase to a maximum and then decrease. An uncorrected set of readings obtained when using a method in which the differential ionisation currents were measured is shown in Fig. 1.

It would appear from these experiments that *a substance is selectively transparent to some at least of the radiations emitted by its radioactive isotope.* A more detailed account of the method of observation and the results obtained will be published in another place.

F. L. HORWOOD.
T. E. BANKS.
T. A. CHALMERS.

Physics Department,
St. Bartholomew's Hospital,
Medical College, E.C.1,
Sept. 3.

Magnetic Moment and the Chemical Bond in Alloys

FORRER,[1] Sadron,[2] and Néel[3] have recently published several articles in which they compute the elementary moments of different substances at small concentrations in nickel alloys. Their empirical results are interesting, but their theoretical conclusions cannot be brought into agreement with modern views on atomic structure.

The empirical material may be re-interpreted on the basis of the following assumptions: 1. According to Stoner,[4] pure nickel consists, at low temperatures, of 40 per cent neutral atoms with zero moment and 60 per cent singly ionised atoms with a moment equal to 1 Bohr magneton (M_B). 2. Every foreign atom entering the nickel lattice becomes singly ionised. 3. The number of ionised atoms in the alloy at low temperatures, with small concentrations of foreign metals, is related to the number of neutral atoms in the same way as in pure nickel. 4. Contrary to my previous view, the conduction electrons do not play any important rôle in ferromagnetism.

With these assumptions, the following values for the effective magnetic moments per atom may be calculated from Sadron's data:

$$Ni^{+}1 \quad Cu^{+}0 \quad Zn^{+}-1 \quad Al^{+}-2 \quad Sn^{+}-3 \quad (M_B).$$

The negative values of the moments of Zn^{+}, Al^{+}, and Sn^{+} correspond precisely to the number of valence electrons left attached to the corresponding ion. This remarkable fact may be interpreted as follows: The positive 1 M_B moment in nickel is produced by one 'missing' electron in the incomplete 3*d* shell, as pointed out by Stoner; while the negative moments are produced by 'superfluous' electrons of the corresponding ions. This leads to the conclusion that the secondary valences are compensated by mutual atomic linkage; so that a Zn^{+} ion destroys one elementary magnet (equal to 1 M_B) in Ni^{+}, an Al^{+} ion destroys the magnetism of two Ni^{+} ions, and a Sn^{+} ion of three. This interpretation enables us to understand why a Pd^{+} ion, which possesses a missing electron, a 'hole', in the 4*d* shell, plays the rôle of a ferromagnetic in nickel, with the same moment as nickel itself. A study of the nickel-iron and nickel-cobalt alloys shows that iron inside nickel has $3M_B$, due to 3 missing electrons, and cobalt $2M_B$, due to 2 missing electrons in the 3*d* shell. The same ionic states are found from susceptibility measurements above the Curie point as from magnetic saturation values at low temperatures. This is shown in the following table:

Metal.	Electronic State of Singly Ionised Atom.	Magnetic Moment from Saturation Value (M_B).		Magnetic Moment from Susceptibility (Weiss units).[5]	
		Calc.	Obs.	Calc.	Obs.
Fe	d^7	3	3·2	22–26	20–22
Co	d^8	2	1·8	14·5–17	15
Ni	d^9	1	1	9–11	8–9

These results seem to open up a new approach to the problems of the chemical bond in metals and of the inner structure of ferromagnetic alloys.

J. DORFMAN.

U.S.S.R., Leningrad (21),
Sosnovka 2, Phys.-Techn. Institute,
July 1932.

[1] R. Forrer, *J. Phys.*, October 1930, p. 325.
[2] C. Sadron, Dissert., Strasbourg, 1932.
[3] L. Néel, Dissert., Strasbourg, 1932.
[4] E. C. Stoner, *Proc. Leeds Phil. Soc.*, 2, 149; 1931.
[5] From solid salts containing ions with the same number of electrons.

Influence of Light on the Gorging of *Culex pipiens* L.

IN connexion with the account given by Dr. Tate and Miss Vincent, in a recent letter to NATURE,[1] of experiments made by them and other investigators regarding the biting habits of *Culex pipiens* in England, the following corroborative observations may possibly be of interest.

During a long series of experiments carried out by us last year, in the course of which female mosquitoes of various species were fed in *daylight* upon human blood, we found that females of *Anopheles maculipennis, claviger, plumbeus*; *Theobaldia annulata, subochrea*; and *Aedes caspius, maculatus, rusticus, detritus, punctor, geniculatus* would bite readily enough. Females of *Culex pipiens*, on the other hand, were

induced to take human blood on seven occasions only, details of these cases being given in the following table:

Number of *C. pipiens* Females induced to bite.	Date (1931).	Time of Day.	Temp. (Cent.).	Percentage Humidity.
1	June 26	4.15 P.M.	18°	—
2	July 22	5.0 P.M.	19°	80
2	,, 23	5.30 P.M.	20°	75
1	Aug. 27	9.30 A.M.	17°	78
1	,, 28	6.0 P.M.	18°	79

In all our experiments, the mosquitoes (whatever their species) were fed in front of a large window facing east. The female *C. pipiens* which bit on Aug. 27 did so in bright sunshine.

It may be noted that, according to Stitt,[2] the yellow fever mosquito, *Aedes argenteus*, may take its first meal of blood in the daytime, but all its subsequent bites are made during the night. This peculiarity is certainly *not* a characteristic of any of the British species with which we have experimented.

Early in May last we collected a number of *C. pipiens* females shortly after the conclusion of hibernation. In those which had obviously fed recently we found, on dissection, the oval, nucleated blood corpuscles pertaining to birds. The adults which appeared to have fed less recently were set aside for oviposition. One of these, after ovipositing, was induced to take two (daylight) meals of human blood, separated by an interval of eleven days; it was found dead, however, two days later. Although fully gorged after the first of these meals, no further oviposition took place and no fat-body accumulated; the insect being found in an emaciated condition when dissected. The ovaries, though not exhausted, had undergone no development.

Of a number of *C. pipiens* females collected during the latter half of last month, eight were found to be gorged with avian blood.

J. F. MARSHALL.
J. STALEY.

British Mosquito Control Institute,
Hayling Island, Sept. 20.

[1] NATURE, Sept. 3, p. 366; 1932.
[2] Stitt, E. R., "Bacteriology, Blood-Work and Animal Parasitology", 1920.

Vectors of Mediterranean Kala Azar

IT has been previously shown[1] that both *Phlebotomus perniciosus* and *P. major* give high infection rates when fed on Chinese hamsters infected with *Leishmania infantum*. In the case of *P. perniciosus* it was also shown that if the epipharnyx is infected flagellates are deposited during the act of feeding. Further work showed that flagellates from *P. perniciosus* when introduced into the skin of susceptible animals (*Cricetulus griseus* and *Citillus citillus*) produce visceral leishmaniasis. It was therefore concluded that *P. perniciosus* is a vector of Mediterranean kala azar.

Transmission by *P. perniciosus* cannot explain the whole of Mediterranean kala azar, for in material collected from Macedonia by officers of the R.A.M.C. during the War we did not find a single specimen of *P. perniciosus*, neither did we find this species in endemic foci in Syria.

On a recent trip through Greece no specimens of *P. perniciosus* were found, but in the neighbourhood of Argos, a heavy centre of infantile kala azar, and in Athens, where both infantile and canine kala azar occur, *P. major* was found to be common. Because of the purely nocturnal activity of *P. major* and its extreme photophobia after feeding, this species has been previously overlooked in Greece.

It was thought advisable to compare *P. major* and *P. perniciosus* as hosts of *L. infantum*. *P. major* is very rare in Malta, but is common in a limited area near Catania in Sicily. A dog naturally infected with kala azar in Malta was taken to Catania, and wild specimens of *P. major* and *P. perniciosus* were allowed to feed on the animal. Out of 31 specimens of *P. major* 25 became infected, while only 33 out of 119 specimens of *P. perniciosus* became infected. The behaviour of the flagellates in the two species was identical. It therefore appears that *P. major* is a better carrier of Mediterranean kala azar than *P. perniciosus* (assuming the identity of canine and infantile kala azar).

S. ADLER.

The Hebrew University,
Jerusalem.

O. THEODOR
(Kala Azar Commission
of the Royal Society).

[1] *Proc. Roy. Soc.*, B, 108; 1931.

The Expanding Universe

IN NATURE of July 2, Prof. Milne has published a very simple and attractive explanation of the phenomenon that has given rise to so much speculation among recent cosmogonists. The sole defect in his clear analysis is that the material particles that form the universe are taken initially to have been enclosed in some finite space, but without mutual action, or even collisions. I should like to bring to the notice of those interested that the last restriction may be easily removed.

Sundman, in his remarkable work on the three-body problem, showed certain general characteristics of the three-body system to persist under Newtonian laws of motion: that if the total energy is greater than that obtained by approach from infinity, under the mutual forces of attraction alone, then at least one of the three bodies will be ejected to infinity. Further, if the energy is less than this critical value and the particles at any time happen to be closer together than a certain determinate distance, the recession to infinity will again take place.

The importance of this lies in that the results can be immediately extended to the n-body problem, as has been demonstrated by Birkhoff, Chazy, Koopman, and others. By studying the Lagrangian R function formed by the products of the masses with the squares of their mutual distances, it can be proved as before that two groups of the particles are to be distinguished: a slower set and a faster receding set; this, provided that the constant of energy is greater than a critical value, or in the contrary case, the R function is sufficiently small at some time, a considerable number of the particles thus being very close together; regardless of the distribution in space or velocity. The further remarkable fact is that this characteristic of exterior motion seems to persist even for more general laws of force than that of the inverse square of the distance, provided that, for attractions, the force vanishes at infinity; certainly for laws of the inverse cube type, and some others.

Lastly, collisions present no difficulty, as the case of elastic rebound can be regularised for double collisions as for triple collisions by the method of Sundman, and collisions of order higher than two will be very rare indeed. This, with the case of Newtonian dynamics, is enough to show the generality of Prof. Milne's remarks. For the relativistic case, the results should be approximated, provided only a finite dissipation of the energy of the system takes place during

the motion, which is also taken to approximate to the Newtonian case as the density tends to zero.

I am, however, unable to say what the movement would be in case the masses at the centre occasion a 'horizon' of the de Sitter type. If electromagnetic components are present among the forces, the paths may remain bounded instead of receding to infinity, as such forces have a 'non-energic' component.

D. D. Kosambi.

Malleswaram, Bangalore,
July 28.

It is very satisfactory to find that the explanation I have given of the phenomena of the expanding universe can be freed from some of the restrictions which were introduced. The essential point in the explanation, as I pointed out, is that we have to do with an unenclosed system; if the system contains some high velocity particles, it will necessarily expand. Mr. Kosambi points out that the expansion and recession to infinity may also occur under more general conditions. But Mr. Kosambi is scarcely correct in saying that in my explanation "the material particles that form the universe are taken initially to have been enclosed in some finite space". I used the finite occupied sphere surrounded by infinite empty space as the most striking illustration of the principle (it was the way the explanation originally occurred to me), but as I explicitly pointed out, any 'initial' density distribution with a concentration towards one region will give rise to the expansion phenomenon; and for the particular relativistic world-structure which I outlined the initial density-distribution extends throughout *infinite* Euclidean space.

The statistical mechanics of an unenclosed system ("a gas-container with the lid off") requires detailed consideration, for it is significantly different from the statistical mechanics of an enclosed system. In particular, the entropy principle no longer holds in its usual form. Maxwell speculated on the consequences of the existence of a velocity sorter, a 'sorting demon'. An unenclosed universe is itself its own sorting demon, and the pessimistic conclusions of Jeans and others as to an inevitable heat-death for the universe must be viewed with doubt.

If point-events are ultimately found to be confined to a finite 3-spread, mathematicians will be entitled to describe the relationships of these point-events by means of a Riemannian metric; but observation has already compelled the introduction of an *expanding* 3-spread if this line of thought is to be retained, with its manifest difficulties, including the re-introduction of an absolute time. In the meantime I prefer to describe these relationships by means of the infinite Euclidean space of any one observer, together with his own particular time. To speak of 'space' itself as curved or finite is of course meaningless, for 'space' is no objective entity; space and time are merely the observer's dissection of that reality which is the change in the observed mutual relationships of observed material particles—what Bergson called "le devenir", or the process of becoming. To describe this reality we may adopt any conceptual space we choose, provided it has the correct number of dimensions.[1] The space of my first paragraph above is the conceptual Euclidean space of any one observer.

The most general scheme of matter and motion for the ground-plan of the universe, that is, the most general description of the above reality, consistent with the observed facts on which the special theory of relativity was based, appears to be given by the distribution-law (for any one observer)

$$F\left(\frac{Z^2}{XY}\right)\frac{dxdydzdudvdw}{c^6Y^2X^2},$$

where X is the invariant

$$t^2-\frac{x^2+y^2+z^2}{c^2},$$

and Y and Z are respectively the covariants

$$1-\frac{u^2+v^2+w^2}{c^2},$$

$$t-\frac{ux+vy+wz}{c^2},$$

x, y, z, t being reckoned from the natural space-time origin of the observer. The distribution I. gave in my synopsis (Nature, July 2, 1932) was the particular case of rectilinear motions, for which

$$F\equiv\frac{\text{constant}}{[(Z^2/XY)-1]^{3/2}}.$$

In general to any function F corresponds a definite acceleration of each material particle and curvature of world lines. The condition that the accelerations near ourselves, for small velocities, coincide with those predicted by the Newtonian law leads to the relation

$$\frac{4}{3}\pi G\rho=\frac{D}{t^2}$$

where G is the gravitational constant, D is a constant less than unity, ρ is the present mean density of the smoothed-out universe near the observer, and t is the observer's reckoning of the time that has elapsed from the space-time origin; t is to be calculated from $V\sim r/t$ where V is the mean observed recession-velocity at observed distance r. This evaluates ρ as not greater than 10^{-27} gram. cm.$^{-3}$.

The possibility of the construction of a universe which appears to *every* observer to be completely centred round himself, wherever he be, and which at the same time thins away at great distances from himself, removes those difficulties which originally led Einstein to adopt a curved finite continuum for the description of the universe.[2] And the fact that we now observe recession-velocities comparable with that of light destroys any justification for the existence of a 'cosmic time', for there is no longer a co-ordinate system in which the observed velocities of celestial objects are all small compared with that of light.[3] In my opinion, these considerations remove many of the traditional philosophical difficulties concerning time and space as a means of description of matter and motion.

E. A. Milne.

Wadham College, Oxford,
Aug. 19.

[1] Cf. Larmor, "Questions in Physical Interdetermination", *C.R. du Congrès Internat. des Mathématiciens*, 1920, p. 13.
[2] See Einstein, *Sitz. Preuss. Akad. Wiss.* (1917), 150, and "Relativity", English Trans. 4th edition, 1921, Part III.
[3] Cf. Einstein, loc. cit., Chap. 32, p. 113.

Inheritance of Acquired Characters

In 1815, Lamarck propounded the hypothesis that all which has been acquired, laid down or changed in the organisation of individuals in the course of their life is conserved by generation and transmitted to the new individuals which proceed from those which have undergone those changes.

This doctrine is at present somewhat discredited and Prof. T. H. Morgan recently asserted that the stories in the folk-lore of primitive peoples which take for granted that acquired characters are inherited appeal to our sense of humour, and would long ago have been forgotten or disregarded by men of science were it not that in every generation new illustrations are continually brought forward.

In adducing such illustrations, the difficulty is to prove that the characters in question are outside the

scope of natural selection, that they are non-utilitarian and not correlated with any useful characters. This difficulty would appear to be obviated in the illustration which is now given.

It is noteworthy that many eminent men were begotten by fathers of ripe age: the father of Francis Bacon was fifty-two years of age, of John Herschel fifty-four, of Robert Boyle sixty-one, of William Pitt fifty-one, of Samuel Johnson fifty-three, of John Hunter sixty-five and of Charles Parsons fifty-four. This suggests that capability may be in some degree an acquired character, and that the older the father the greater the chance of it being acquired.

An attempt has been made to determine whether

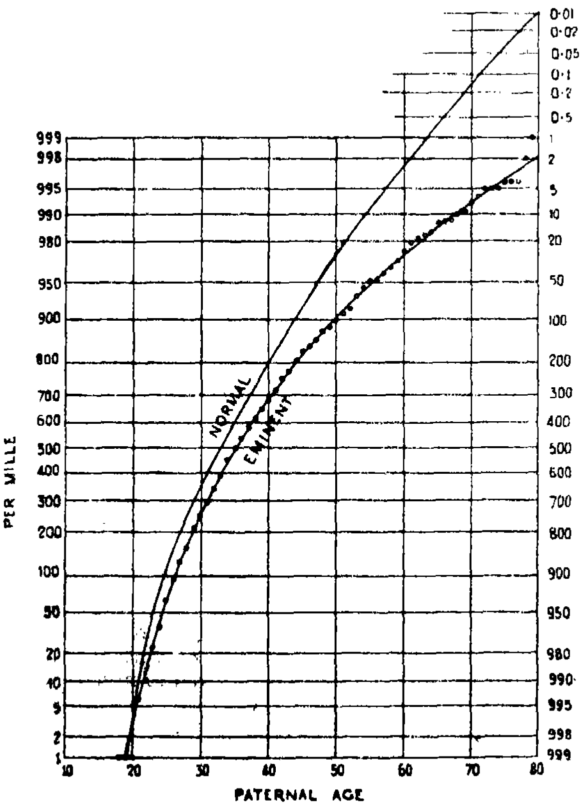

FIG. 1.

this can be substantiated. In the "Encyclopædia Britannica" (Fourteenth Edition) one thousand persons are noticed (exclusive of those mentioned on account of inherited titles) for whom the date of the father's birth is given. These are considered to be of outstanding capability and the paternal age has been compared with that for a more normal population.

The comparison has been made by plotting upon permille paper [1] the frequency distribution of the paternal age both for the eminent thousand and also for one hundred thousand children under one year recorded in the census of Scotland for 1921 (see Fig. 1).

This simple investigation appears to show that capability is an inheritable character acquired by those of mature years. The difference between the two curves in the figure is so striking—the proportion with paternal age more than forty-five years is twice, more than sixty years ten times, and more than seventy years fifty times the normal—that it is thought well to publish the facts without proceeding to examine other statistics.

In compiling the data, it was observed that the grandfathers of many eminent men were of ripe age; Ruskin's father, who was only thirty-five years of age, was born when his father was fifty-three years of age.

A. F. DUFTON.

Greenbank, Garston,
Hertfordshire, Sept. 1.

[1] *Phil. Mag.*, **10**, 556; 1930; and **11**, 454; 1931.

Observations on Filmed and Filtered Vowels

REFERRING to Mr. W. E. Benton's letter on vowel sounds,[1] there is a further point to which attention may be directed, namely, the effect of the changes of attitude or 'expression' of the larynx and adjoining parts which accompany vowel formation.

At the International Phonetic Congress at Amsterdam, last July, Dr. Oscar Russell demonstrated the action of his own larynx while articulating various vowel sounds. It was evident that the laryngeal region is very active, and shows a different attitude at each change of vowel.

On the other hand, as Mr. Benton points out, the behaviour of my models showed that recognisable vowel sounds are produced by passing the vibrations of a reed through a pair of suitably tuned resonators in series. It also showed that a complete range of voiced vowel sounds could be produced, over a considerable musical range in each case, by simply altering the effective length of the vibrating reed.

The elaborate adjustments of the laryngeal region are evidently not essential to vowel production; they probably assist by providing in each case a fundamental vibration having overtones in the regions of frequency characteristic of the vowel in question.

Dr. Russell also articulated—in a whisper—some of the so-called voiced and unvoiced consonants (B, P; V, F), and it was apparent that, in this case also, the laryngeal region takes an active part in differentiating the 'voiced' from the 'unvoiced' sound, when both are whispered. This, incidentally, confirms the conclusion which I had drawn [2] from the behaviour of models.

The exact nature of the human adjustments requires investigation.

At my request, Dr. Russell also varied his facial expression while I watched his larynx. It was seen that at each change of facial expression—from a smile to a scowl, for example—there was also a change of expression in the laryngeal region.

This correlation—which also needs detailed investigation—offers a simple explanation of the emotional language of phonation, and completes the gestural picture of human speech.

The mouth gestures of articulation correlate with pantomimic hand or bodily gesture, and the changing attitudes of the laryngeal region correlate with changes of facial expression.

R. A. S. PAGET.

1 Devonshire Terrace,
London, W.2, Sept. 13.

[1] NATURE, Sept. 24, p. 475.
[2] *Proc. Roy. Soc.*, A, **114**, 98; 1927.

Electron Oscillations

LAST year I made a series of observations on short-wave oscillations in three-electrode valves with positive grid. Details of the experiments will be published elsewhere, but a brief account here, in relation to a theory on the mechanism of these oscillations, as electron oscillations, which I have worked out recently, may prove interesting.[1]

The experimental arrangement was similar to that used by most workers,[2] differing only in a few details.

A system of parallel wires was attached to the grid and plate terminals of the valve. For every position of a movable condenser joining the wires there was a definite pair of values for the grid potential V_g and the emission current i_e which set up oscillations of maximum strength. From V_g and i_e, and from the construction data of the valve, it is possible to calculate the total number N of the electrons between grid and plate.[3] In Fig. 1 the observed wave-lengths λ are plotted against the values $1/\sqrt{N}$ for the following valves: Philips D II, Z I, TA 0810, Radiotechnique R 5, Zenith W 20 A.

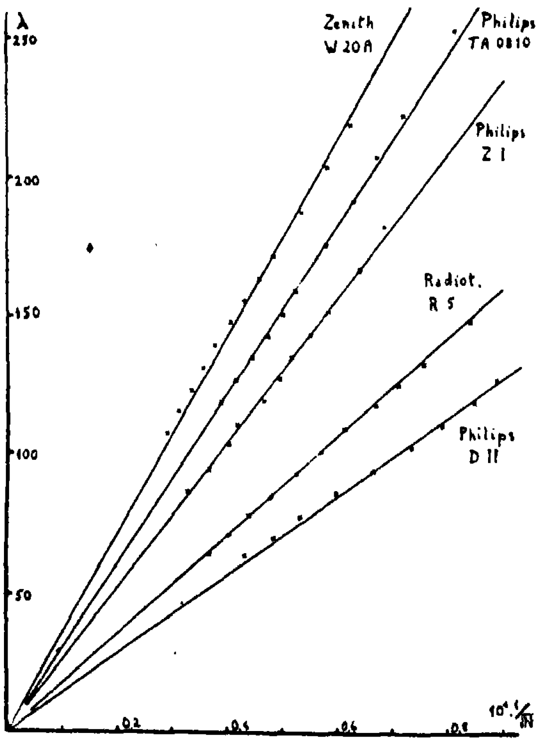

FIG. 1.

The experimental data seem to follow closely enough the theoretical relation $\lambda\sqrt{N} = \text{const} = K$. The values of the constants K for different valves (representing the tangent of the straight lines in the figure) are in reasonably good agreement with the theoretical value (calculated for parallel plane electrodes, omitting space charge effects) $K = 3{\cdot}35 \times 10^6\sqrt{v}$, v being the volume comprised between grid and plate of the valves; this is shown in the following table:

	v.	K.	$K/\sqrt{v}$.
Phil. D II	0·35	$1{\cdot}42 \times 10^6$	$2{\cdot}40 \times 10^6$
Rad. R 5	0·47	$1{\cdot}76 \times 10^6$	$2{\cdot}57 \times 10^6$
Phil. Z I	1·00	$2{\cdot}59 \times 10^6$	$2{\cdot}59 \times 10^6$
Phil. TA 0810	1·16	$3{\cdot}06 \times 10^6$	$2{\cdot}84 \times 10^6$
Zen. W 20 A	1·50	$3{\cdot}60 \times 10^6$	$2{\cdot}94 \times 10^6$

ANTONIO ROSTAGNI.

Physical Institute,
University of Turin,
July 31.

[1] *Atti R. Acc. Sc., Torino*, 66, No. 1, p. 123; No. 2, p. 217; No. 3, p. 383; 1931. E. W. B. Gill (*Phil. Mag.*, 13, 734; 1932) seems not to have noticed that in these papers I showed in particular how the condition for the maintenance of the oscillations $\int eidt < 0$, is satisfied (No. 1, p. 128; No. 3, p. 393).

[2] See, for example, E. W. B. Gill, *Phil. Mag.*, 44, 161; 1922.

[3] *Atti R. Acc. Sc., Torino*, 66, No. 1, p. 123; No. 3, p. 383; 1931.

Science Teaching in Schools

IN several recent issues of NATURE it is suggested that the science teaching in schools is lifeless and dominated by the curse of useless external examinations. I learn that as a result there is little scientific interest or knowledge among the masses, and finally I am cast down by a fearsome picture of the horrors of the machine which science has created.

Turning for consolation to educational periodicals and my colleagues, I find the same story and an atmosphere of desolation such as one associates with a Russian novel.

Unfortunately, this is all true. I cannot say that the position has been exaggerated or put without moderation. Surely the state into which we have drifted has been outlined clearly enough to demand that it is now time to *do* something. Surely science teachers can get together and devise some way out of our trouble, despite the handicap which our specialised university training has given us. Government regulations make it a condition of State aid that a school shall provide facilities for the teaching of science. State-recognised examinations, towards which that teaching is supposed to lead and by which it is valued, permit of a pass on 'Heat, Light, and Sound'.

It is useless to blame the examiner or the teacher. It is the system which accepts such outward and visible signs in place of inward grace which must be fought. Would it not be possible for those of us who have not died mentally under the strain, to band together with the sole aim of improving the outlook? We can leave the economics of the profession to the professional associations. We can sink differences of opinion and teaching rank, and whether elementary school or university teachers, pledge ourselves to claim, in season and out, our right to teach science and not just 'Heat, Light, and Sound'.

The pages of NATURE have been used with moderation and wisdom in outlining this problem. May we look to NATURE to give a lead to such a crusade? It is not the task of many individuals, but of a united body, the members of which are fired with that spirit of untiring pursuit which has marked so much of the history of science.

W. F. F. SHEARCROFT.

The King's School,
Peterborough.

The Sense of Smell of Cats

I HAD a favourite cat which was having fits and becoming dangerous, so, to destroy it as painlessly as possible, I inserted several grains of morphia in the centre of a piece of foie gras which was cut in two, great care being taken that no morphia was spilt on the outside. The cat on being shown the foie gras expressed in every way its eagerness for it, but when it got within three feet of the foie gras, turned round and looked at me with intense astonishment, and then after another sniff walked away, though previously it had always worried for a small piece. The special point is that the cat could detect something dangerous through the strong smell of the foie gras, though morphia, even in considerable quantities, has to most persons only a faint odour.

F. W. EDRIDGE-GREEN.

99 Walm Lane, Willesden Green,
London, N.W.2,
Sept. 13.

Research Items

Anthropometry of the Maya Indians.—In accordance with the policy of the Carnegie Institution (Washington) for making Chichen Itzá, Yucatan, a focal point for correlated research in the archæology, anthropology, linguistics, and biology of Yucatan, Dr. Morris Steggerda, of the Department of Genetics of the Carnegie Institution, has undertaken a study of the physical and physiological characters of the Maya of the villages in the neighbourhood of Chichen Itzá (Publication No. 434, Carnegie Institution). 77 males and 56 females were examined, also 135 children; but the report on the children will appear later. The average age of the male subjects was 30·6 years, of the females 28·8. They claimed to be pure Maya, and although probably no genetically pure Maya exists in Yucatan, they may be regarded as relatively pure, with not more than one-eighth to three-sixteenths Spanish blood. The average eye colour is dark brown, and of the hair, black. The stature is 155·2 cm. for males and 142·8 cm. for females, a range of 10-15 cm. less than United States Indians. Their arms are long in relation to the stature, the lower arm in particular being longer in relation to the whole arm than in the white. They have broad shoulders, being as broad as Plains Indians, who are considerably taller. The Maya is very broad-headed, the cephalic index being 85, the females being 1·2 per cent more than the males. The face is broad, the nasal index still leptorrhine, the ears long and narrow. The relative chest girth in the Maya is astonishingly great, being 56 per cent of stature in males and 58 per cent in females, as against 53 and 55 per cent for whites and 51 per cent for negroes of both sexes. The teeth are very good, 42 per cent of 88 adults having perfect teeth. The pulse rate of the Indian is low and the metabolism high, when compared with whites and negroes.

English Loan-words in Hindi.—According to a study of English loan-words in Hindi by Dhirendra Varma in *Allahabad University Studies*, vol. 8, pt. 1, an "English-educated middle-class gentleman" can scarcely speak a sentence in Hindi without using some English words; and thus a Hindi jargon has grown up which is used invariably by the "English-educated" when speaking among themselves. Among uneducated Indians, English loan-words are in use with a vernacular pronunciation, which conforms to certain phonetic rules or principles. From the point of view of meaning, these words may be classified under certain main heads: (1) words used to convey ideas connected with foreign institutions, such as courts and offices, military and police, educational system, transport and communications, for example, kālij (college), injīniar (engineer), ōbarsiar (overseer); (2) articles introduced by foreign influence—dress, food and drink, machinery, objects of recreation, for example, burus (brush), baeslin (vaseline), timātar (tomato), pancar (puncture). In phonetics, an unfamiliar English sound is replaced by the nearest Hindi sound, while in some cases awkward sounds are dropped or new sounds are introduced to facilitate pronunciation, for example, engine becomes anjan, officer, āphsar; diphthongs are converted into simple vowels, for example, paetmaen, pointsman; a vowel appears to avoid conjunct consonants, phāram, farm, kilark, clerk; or by prothesis, istēsan, station, iskūl, skull, astabal, stable. In consonantal changes, cerebral or dental sounds are substituted for English alveolars, for example, darjan, dozen, Sitambar, September; *c* and *j* are substituted for *t*, *f*, and *dz*, for example, cāk, chalk; *f* and *th* are changed to the nearest stops, that is, *ph* and *th*, for example, phutbāl. By metathesis, general becomes jarnael, and signal singal; *l* is substituted for *n*, for example, lambar for number, and lemonade becomes lamlēt or laemunat, and so forth. The loan-words are mostly nouns. Neuters are assigned to masculine or feminine indifferently; while for purposes of declension English loan-words are treated like Hindi nouns. A full list of loan-words is appended.

Carbohydrates in Relation to Disease.—The abundance of cheap sugar is not only an embarrassment to the sugar industry, but, according to Dr. J. H. P. Paton, also brings risks in connexion with disease (*Edin. Med. J.*, **39**, No. 9, p. 556). Dr. Paton estimates that the average consumption of sugar is now in the neighbourhood of 100 lb. a head per annum. Sugar, as we use it, is not a natural food, and is devoid of all accessory food substances. Excessive consumption of sugar tends to upset digestion, is a factor in the production of rickets and dental decay, and leads to retention of water in the body, with an increased tendency to catarrhal affections. It is probably responsible for the increasing frequency of acidosis in the modern child, and it throws additional work on the pancreas, which may result in degeneration of this organ and diabetes. Experimentally, an abundant supply of glucose promotes the development of cancer in mice, and carbohydrate excess may therefore be one of the factors causing the increased prevalence of cancer.

African Birds and Temperature.—Dr. F. M. Chapman has shown that the distribution of bird-life in South America can be associated with climatic zones related to temperature, and applying a similar analysis to the birds of Africa, W. Wedgwood Bowen has found a zoning comparable to that in South America (*Proc. Acad. Nat. Sci. Philadelphia*, **84**, 259; 1932). Knowledge of the distribution of many species is too inadequate to permit a thorough analysis of the zonal relationships; but, ignoring the alpine and temperate zones, a rough analysis shows that 599 species are limited to the tropical zone and 550 to the subtropical zone, while only 100 occur indifferently in both zones, although 254 more which are common to both zones show subspecific differences which appear to be related to temperature. That is to say, of 1500 species only 100 appear to exhibit no change attributable to temperature. Although the distribution of the vegetation belts in Africa is mainly determined by rainfall, yet the study of Shantz's vegetation map shows that, with one notable exception, each of the various vegetation types may be classified roughly according to life zones (apparently not a chance distribution), and even the exception, the "acacia—tall grass savanna", which ranges widely through tropical and subtropical zones, may, the author thinks, be divisible, from the point of view of bird distribution, into tropical and subtropical portions.

Butterflies of the District of Columbia.—Bulletin 157 (1931) of the United States National Museum is devoted to an extensive memoir (366 pp.) entitled "The Butterflies of the District of Columbia and Vicinity". Its author, Mr. Austin H. Clark, who is curator in the Museum, has in this work provided an admirable non-technical guide to the rich butterfly fauna of the area under consideration. Each species is discussed at variable length, according to any special features of interest associated with it. Also, each species has one or more illustrations devoted to

it, and these figures are comprised in some sixty-four half-tone plates bound at the end of the letterpress. In the long introductory chapter the author contributes a number of interesting remarks and observations on butterfly behaviour. Of especial note is the section dealing with pressure of population, since, in many of the species, he finds that if the males increase beyond a certain proportion they seem incapable of living amicably together in the presence of the females. A familiar sight is a shrinking puddle tenanted by gay companies of newly emerged male butterflies. These, according to the author, are examples that have been driven from over-populated areas by being incessantly tormented by other males. Requiring water, these fugitives naturally resort to the moisture found in puddles, where, in the absence of the females, they exist peaceably. Many of the common roadside butterflies are also stated to be exiles and consist of newly emerged males. They appear to be unable to cope with the older males in their natural habitats and are driven to areas beyond where the females live. As they mature, and the older males die off, they are able to fly back to the fields and, in their turn, drive out any younger and less lusty rivals. Sections devoted to butterflies and storms, the extermination of one species by another, migration, and other features of the biology of these insects are also included in this paper.

Storage of Fruit by Freezing.—Dr. J. Barker and Mr. T. Morris have just published a very interesting leaflet on the comparative values of different methods of storing fruit by freezing (Dept. Sci. and Ind. Res. *Food Investigation Leaflet* No. 2, 9 pp., 1932). The principles and practice of preservation by cold storage are discussed. Freezing alone often results in an inferior product due to the activities of enzymes when thawing takes place. Refrigeration with sugar or syrup prevents the browning of such fruits as plums and cherries during storage, and the destruction of the enzymes of peas or beans by heating slightly before cold storage gives successful results. Quick freezing and freezing in a vacuum or under an inert gas have also been investigated. The special considerations relating to the cold storage of English plums are set forth by Dr. Franklyn Kidd and Dr. C. West in *Leaflet* No. 1 of the same series (6 pp., 1932). The effects of storage temperature, handling, fungal rotting, packing, type of store, and climatic conditions before harvesting are all discussed. The report, though short, gives the results of ten years' intensive work upon the problem.

Bacteriophage of *Pseudomonas radicicola*.—An interesting paper entitled "Studies on Bacteriophages of the Root Nodule Organisms", by Dr. S. V. Desai, dealing with the effect of certain bacteriophages on the activity of the root nodule organisms of leguminous plants, has recently appeared (*Indian J. Agr. Sci.*, vol. 2, pt. 2., 1932). Several strains of bacteriophage were isolated, and it was found that media which were suitable for initial separation were not good for the increase of virulence of the bacteriophage. The different strains were not specific for the various strains of the bacterial host, and it is suggested that there is only one bacteriophage for *Pseudomonas radicicola*, no matter what its host plant may be. The lytic principle was inactivated by heating to 75° C. for five minutes. The results suggest further experiments to determine what part the bacteriophage plays under field or garden conditions. It has been found difficult to separate the organism and its bacteriophage, and it seems possible that the presence or absence of the latter may bear an intimate relation with the observed behaviour of the former.

Correlation of Coal Seams by Plant Spores.—The correlation of coal seams has usually depended on consideration of the associated shales and, in particular, the fossil-bearing bands. One of the most characteristic features of coals are those plant remains which have escaped destruction in the process of coal formation. Of late years, the means for identifying and even isolating the spore exines which are resistant to decay have been perfected and thus provide a method of correlation which may offer advantages over the study of fossils in adjacent strata. This method has been applied to the Parkgate seam in the Yorkshire area, and the Fuel Research Division of the Department of Scientific and Industrial Research has now, in Paper 23 of the Physical and Chemical Survey of National Coal Resources entitled "The Significance of Spores in the Correlation of Coal Seams" (H.M. Stationery Office, 2*s*. net), reported the extension of the study to the Barnsley and Silkstone seams in the same area. In all, 30 types of spore have been distinguished, and although most of them are too few in number or too irregular in distribution to use in identification, there is evidence that certain types are characteristic of certain seams, and the force of these conclusions may grow with increase in the number of observations.

Swedish Rainfall.—The report of the Swedish rainfall stations for 1931 has been published by the Statens Meteorologisk Hydrografiska Anstalt in the Årsbok, No. 13, pt. 2. The data come from 698 stations spread throughout the State. Their distribution is shown on a large-scale map. For every month in the year there is a detailed record of every station and a map of the rainfall. The year proved to be exceptionally wet, with a rainfall that averaged 142 per cent of the normal over the whole country. Only two provinces had a year's total below the average, and many had more than twice the normal rainfall. On the whole, the northern parts were the driest and the areas of the central depression the wettest.

Existence of a Heavy Lead Isotope.—K. Murakawa has published recently a note on the hyperfine structure in the spectrum of lead (*Scientific Paper* No. 371, Tokyo) which illustrates both the value and difficulty of such work. In it he confirms the existence of the light lead isotope Pb^{204} found by Schuler and Jones in a similar manner, but also claims, in opposition to Kopfermann, that there is a satellite to λ4057 which must be attributed to a heavy isotope Pb^{210}. He finds similar satellites to λ3683 and λ4387. A Lummer-Gehrcke interferometer pattern for 4387 is reproduced showing the supposed Pb^{210} component, although without the corresponding microphotometer record. The abundance ratio for Pb^{204} and Pb^{207} is given as 1 : 25, and the ratio for Pb^{204} and Pb^{210} as 8 : 1.

Thermionic Emission.—The subject of thermionics has developed in a few years from the method of studying the electrical properties of matter to being the basis of one of the world's widest commercial applications of physical science. Richardson was the first to state, thirty years ago, that electrons, normally retained in a substance by a potential discontinuity at its surface, are able, when the body is heated, to escape through the surface and so constitute an electric current. The literature of the subject is now widespread and much of it is very abstruse. It was decided by the Radio Research Board that a critical survey of the literature would be of real value to engineers and other scientific workers. The work was entrusted to Dr. W. S. Stiles, of the National Physical Laboratory, and is now published (Radio Research Report No. 11. London: H.M.S.O., 2*s*. 6*d*.). The author

gives a clear and comprehensive survey of all the main results obtained in researches in the various branches of the subject, together with a lengthy and carefully compiled bibliography, which includes references to all the important papers published up to December 1930. This book will prove of great value to everyone interested in thermionics. The author sometimes gives useful hints showing how formulæ given by different authors can be reconciled. His abstracts also will enable the investigator to see what original papers he should consult.

Highly Cracked Gasoline.—In the April number of *Industrial and Engineering Chemistry*, Messrs. C. R. Payne and Alexander Lowy give an interesting account of their work on the study of composition of cracked petrol before and after heat-treatment. Their method, briefly, was to subject this petrol to a temperature of about 300° C., which is actually below the temperature employed in the cracking process, and they reached some interesting conclusions. It was found that the percentage of unsaturated hydrocarbons was decreased by the heat and pressure treatment in all the fractions isolated. The percentage of naphthenes in the whole distillate up to 201·5° C. was increased by the treatment. Additional changes are considered to be attributable to polymerisation, such as increase of material boiling above 201·5° C. by about 4 per cent; disappearance of probable presence of cyclo-alkenes; and formation of hydrocarbons containing hydrogen atoms easily replaceable by halogen. Regarding the composition of the cracked petrol, benzene and toluene were identified in selected fractions; in one fraction, boiling from 20·4° to 35° C., the presence of methylcyclobutane was inferred. A further interesting point is that, in general, the proportion of unsaturated hydrocarbons tends to decrease as the boiling point increases; while in a similar way, the proportion of paraffinic hydrocarbons decreases, and the percentage of naphthenes and aromatics increases, as the boiling point is raised. Although the paper is a comparatively short one, it contains some valuable data on the physical and chemical properties of the various fractions, not easily accessible elsewhere; in particular, the refractive indices on ordinary and treated fractions provide some interesting contrasts.

Astronomical Topics

The Total Solar Eclipse of Aug. 31.—Further bulletins from Science Service, Washington, indicate that several observing parties obtained a fair measure of success. The U.S. Naval Observatory party at Limerick, Maine, was able to carry out its full programme, though thin cirrus cloud was passing. The General Electric Company sent up an aeroplane at Concord, N.H., which reached perfectly clear sky: the moon's shadow was seen for three minutes before and after totality. The Harvard party at Portland, Maine, had a completely clear sky. The Greenwich party at Parent obtained a satisfactory photograph of the flash spectrum extending from H_a to the H and K calcium lines; but the attempt to obtain the infrared portion failed.

At least three different parties of observers, seeing that conditions at their stations were almost hopeless, made dashes by motor cars to regions where the clouds were less dense, and were successful in obtaining views of the eclipse, though of course there was not time to transport large instruments. Excellent roads contributed to the success of this novel resource.

Astronomical Notes for October.—Venus is well placed for observation as a morning star in Leo; it has passed its greatest brilliance, but is still of magnitude −3·7. The illuminated fraction of the disc increases from 0·62 to 0·73, the diameter diminishes from 19″ to 15″. There is a conjunction of Venus and Jupiter (distance apart 7′) on the morning of Oct. 20; they will be high enough for convenient observation soon after 4 A.M.; it will give an opportunity to compare their surface brightness, and hence their albedoes.

Mars is a morning star, moving from Cancer to Leo; its diameter increases from 5″ to 6″; it will be nearly 14″ at the nearest approach to the earth on March 3. Mars will remain fairly near Jupiter throughout this apparition; their least distance apart will be 16′ on June 4. Mars will make a near approach to the moon's south limb at 6.40 A.M. on Oct. 24 next. There will be an occultation in Scotland.

Saturn is still observable in the early part of the night; it is stationary in the eastern part of Sagittarius. The ring has begun to close; its major axis is 38″, its minor 14″; it will be edgewise about the end of 1936.

Uranus is well placed for observation, being in opposition on Oct. 14; it is in the eastern part of Pisces; its diameter is 3·6″; a map of the faint stars near it is given in the B.A.A. Handbook for 1932. Its magnitude is 5·9, so that it is visible to a good eye.

There are two occultations of fifth magnitude stars visible in London; one disappears on Oct. 11 at 6^h 58½^m P.M., 40° from the north point; the other reappears on Oct. 20 at 2^h 36½^m A.M., 230° from the north point.

Comet Peltier-Whipple was visible to the naked eye at the end of August; it is now fainter, but still observable with moderate telescopes; the following ephemeris (for 0 hours on the days named) is a continuation of one by Messrs. Anderson and Cherrington (Harvard Card 239).

	R.A.	N. Decl.
Sept. 30	13^h 47^m 21^s	56° 40′
Oct. 4	13 52 52	54 37
8	13 57 36	52 49
12	14 1 39	51 15
16	14 5 18	49 52
20	14 8 36	48 40
24	14 11 40	47 36
28	14 14 31	46 41
Nov. 1	14 17 12	45 55
5	14 19 41	45 17

Ephemerides for several periodic comets now under observation are given in the B.A.A. Handbook for 1932. It is to be hoped that all who have the means will join in the search for Tempel's comet of the November meteors; if the estimated date of perihelion is near the truth, it would be in Cancer or Leo during October. Search should also be made for Brooks's comet; it is in Pisces, and should be nearly midway between the two ephemerides given in the Handbook.

The most conveniently observable minima of Algol occur on Oct. 11 about 10^h 36^m P.M., and on Oct. 14 about 7^h 24^m P.M.

Summer Time ends at 2^h A.M. on Oct. 2; after that date the times given here are those shown by ordinary clocks. It is well to note that astronomical records should never be made in Summer Time, but always in true Greenwich time.

Forestry in Mauritius

CONSIDERABLY more than twenty-five per cent of the island of Mauritius is occupied by forests and rocky mountains which lie outside the cultivated area. As is pointed out in the Annual Report of the Forest Department of Mauritius for 1930, the great density of population, the small area of the forests (Government forests, Crown and other forest lands, total 92,050 arpents or about 95,732 acres) and the demands made upon them, the many uses to which wood is put, and the local dependence on imported timber, all point to the vital importance of forestry in the island. Since the forests lie mainly on the top and slopes of the central plateau, from which all the important rivers run, it is obvious that their preservation is equally vital to the maintenance of the premier industry of sugar cultivation, in order to prevent erosion and its destructive aftermath, and to secure the maintenance of water supplies, and so forth.

During the year effect was given to a scheme of reorganisation of the Department, in order to introduce better methods of control and to permit of future development. It is unfortunate that this scheme, which reflects the highest credit upon its authors, should have so nearly coincided with present financial stringency. Nevertheless, when the chief commercial interest of the Colony is so intimately bound up with its forests, it may be confidently expected that the recognition accorded to the importance of the Forest Department may not be withdrawn owing to what, it may be hoped, is a temporary financial embarrassment.

The climate of the central plateau of the island is cool, windy, and wet. The two southern masses of forest are by far the largest, and from them the Grand Bassin Division (30,000 arpents) and the Midlands Division (21,000 arpents) have been formed (1 arpent equals 1·044 English acres). The northern block of forest comprises the Nouvelle Découverte Division, of about 5700 arpents. The Divisions are mainly State forest, with some privately owned mountain reserves along the boundaries. Grand Bassin Division contains 2800 arpents of mountain reserves, Midlands Division 500 arpents, and Nouvelle Découverte Division 1000 arpents.

About one-half of the staff is engaged outside the forests in protecting the mountain, river, and road reserves, administering the laws governing those reserves, working the small isolated State forests, and inspecting leased Crown lands, notably a strip of land round the coast, known as Pas Géométriques.

Forest management is under the control of a Forest Board, which held seven meetings during the year, the subjects under consideration consisting of the working of the land purchase scheme, the management of the mountain reserves, and the forms of lease for the Pas Géométriques.

A considerable amount of forest survey work was undertaken, 500 miles of boundary lines cleaned of weeds, and stock maps of the growing stock on 3470 arpents of forest prepared. Roads and a tramway line were also under construction to facilitate the extraction of timber and fuel.

Experiments in afforestation work and the rearing of exotics have been in hand for some years, and recently this work has made great strides. Wide spacing was formerly made use of in plantations, but the policy is now to plant closer, and a considerable amount of work in filling up the old wide-spaced plantations has had to be undertaken in order to obtain satisfactory crops. Tending the new plantations is also given careful attention, and plantation control books have been introduced, the officer concerned filling up data of growth and so forth twice in the year—a most excellent provision. On the subject of this work, the conservator, Mr. G. N. Sale, writes: "During the past fifty years numerous species [of exotics] have been tried, and many found to be suitable for plantations. This work was continued in 1930, and success was obtained in the nurseries with *Pinus caribœa*, which germinated and grew even better than *Pinus tæda*. It is to be hoped that this valuable tree will prove as vigorous in the forest as in the seed-bed. *Pinus palustris* formed luxuriant foliage, but no leader. *Pinus sylvestris*, *Sequoia sempervirens*, and *Ormosia semicastrata* failed in the Nursery."

Animals, especially deer, and weeds appear to be the chief dangers which the forests have at present to fear. It is said that "the number of deer is kept as high as possible by the Lessees of the Shooting Rights over nearly the whole of the State forests". It is not stated what rent is obtained from the lessees; in the latter part of last century, when the King of Saxony desired to have an excessive number of deer maintained in the State forests, he paid a considerable rent for the feeding of the animals during the winter months, and for excessive damage done, in addition.

Under the heading of utilisation, some interesting information is given on the subject of timber and fuel. Most of the timber obtained during the year came from Belle Rive, in Midlands Division. "The timber was extracted partly in the form of logs, which were sent to the Match Factory. Pine scantlings were sold to the Harbour Engineer, who worked the timber, soaked it in fuel oil and used it in the Granary. This form of impregnation was adopted by the Forest Department, and the results will be watched with interest. If the Chinese Pine timber can easily be rendered immune from the attacks of White Ants, the plantations made from 1885 onwards should supply material of the greatest value to the Colony during the next twenty years. The Pine timber proved fairly satisfactory in seasoning, and did not split and twist to any great extent, but the timber of *Eucalyptus robusta* was very difficult to season." The forest felled was apparently patchy; eucalyptus had outgrown the pine, developing large spreading branches. The timber not being straight-grown, it warped and split badly, especially when sawn into boards and planks. Straight-grown eucalyptus, especially *E. tereticornis* and 'E. hybrid', would, it is believed, yield very good boards when carefully seasoned. It is stated that the demand for indigenous timber is steady, if not large; 'plantation timber' of exotic species is much less popular. "It will not be possible to produce any considerable supply of indigenous timber, and it is hoped that when the public becomes accustomed to well seasoned exotic timber, this prejudice will disappear."

Whilst it is obviously to the interest of the Colony to endeavour to raise in plantations such a proportion of exotic timber material as will reduce the imports, yet the neglect to maintain and obtain the regeneration of at least a portion of the indigenous forests would not, we believe, be in the true interests of the Colony or its future. An entire reliance on introduced species is dangerous, and is probably uneconomic in the long run.

A suggestion might be proffered on the subject of the tabular statements in the appendix series. These are not in some cases easy to follow, and in Appendix 9 no totals are given. A statement of the imports of timber and other forest produce into the Colony would be useful. With this minor criticism, it may be said that the Report under review has many points of unexpected interest, and reflects credit upon the Governor, the Forest Board, and the Conservator.

Lighting and Light Sources

AMONG the papers presented in Section 6 of the International Electrical Congress, recently held in Paris, was one by Dr. Pirani, of the Osram Gesellschaft, who gave a very interesting account of recent developments in the production of light. After a general description of the underlying principles of the modern discharge tube, he dealt in more detail with the two types showing the greatest efficiency, namely, the sodium tube and the mercury tube. In the case of the former it has been found experimentally that the addition of one of the rare gases at a pressure about a thousand times as great as that of the sodium vapour is of considerable advantage. Since the atoms of the rare gas require a very high voltage to excite them, they act principally as elastic obstacles in the path of the electrons and so increase a hundred-fold the distance which an electron travels on its journey from the cathode to the anode. The chance of a collision between the electron and an atom of sodium is thus correspondingly increased. When the tube is operating under the most favourable conditions, 70-80 per cent of the energy of the electrons is transformed into light. An over-all efficiency of about sixty lumens a watt can be obtained from a sodium tube.

In the case of the mercury tube, the intensities of the lines in the longer wave-length part of the spectrum are much increased, relatively to the others, by increasing the pressure in the tube to one atmosphere or more. This is illustrated by diagrams showing the relative intensities of the different lines for two tubes operating at pressures of 0·5 mm. and 3 atmospheres respectively. The result is naturally a very great increase in luminous efficiency and lamps can be operated to give 50 lumens a watt. The possibilities of light production by the excitation of gases in the molecular state, and of liquids or solids, are discussed by the author in a final section of his paper, but he concludes that the most hopeful line of work lies with gases in the atomic state or with vapours.

A new type of mercury arc in quartz, stated to have an efficiency of some 10 candles a watt, was described in a paper by Prof. Cz. Reczynski of Poland. It depends on the reduction of the cathode potential drop from 100 volts to about 5 volts by (*a*) using for the cathode a ball of tungsten instead of mercury, and (*b*) placing a tungsten filament at a short distance away from the cathode.

In an interesting communication from Japan, Dr. R. Kurosawa described a method of studying the characteristics of a diffusing material, as regards transmission and reflection. The brightness (not the candle-power) of a sample of the material is measured at all angles of view, the light being incident normally. The measurements are most conveniently carried out by means of a photoelectric cell (that employed by the author is a vacuum type cæsium cell), an image of a given area of the surface of the material being formed on the sensitive surface of the cell. The author recommends Halbertsma's definition of diffusing power (σ), that is,

$$\sigma = \sum^{n} \beta(\theta)/n\beta(o)$$

where $\beta(\theta)$ is the brightness at an angle θ to the normal and n is the number of directions in which measurements are made. The author considers that three measurements, at the angles $22\frac{1}{2}°$, 45°, and $67\frac{1}{2}°$, are generally sufficient. Since $\beta(o)$ cannot be obtained by direct measurement in the case of reflection, it must be deduced by extrapolation from observations made at the above three angles, using Lagrange's formula $\beta(o) = \sum^{3} R_i \beta\left(\frac{i\pi}{8}\right)$ where $R_1 = 1·5412$, $R_2 = -0·6682$, $R_3 = 0·1270$. A nomogram is given in the paper for finding σ from the observed values of β_2/β_1 and β_3/β_1, using the formula deduced by the above method, namely,

$$\sigma = (\beta_1 + \beta_2 + \beta_3)/(4·62\beta_1 - 2·00\beta_2 + 0·38\beta_3).$$

The subject of glare in lighting installations was considered in two papers presented in this section. M. J. Dourgnon, defining glare as the threshold sensitivity of the retina at a given point A (for example, the fovea) with the eye exposed to any given field, proposed that the glare produced by a uniform field having a brightness equal to 1 candle per square cm. should be adopted as the 'unit of glare'.

Ing. J. Ondracek, of Austria, dealt principally with the time required for the eye to adapt itself when the gaze was transferred from a surface of high brightness to one of low brightness, or vice versa. This time is a function of the *average* brightness of the two fields of view and may be expressed in terms of the ratio of these two brightnesses. In the practical case, one brightness is that of the surface being worked upon, while the other is the average brightness of the surroundings, for example, ceiling, walls, and floor.

The use of photoelectric cells for colorimetry was described in a paper by Dr. N. R. Campbell, who outlined the method of colour-matching electric lamps by the use of two cells having markedly different sensitivity curves, and the use of the Toussaint photoelectric colorimeter for giving a rough indication of the spectral distribution of the light reflected from a coloured surface.

Evaporation, Condensation, and Adsorption

DR. I. LANGMUIR (*J. Amer. Chem. Soc.*, July) has extended his well-known adsorption formula by taking account of the forces between adjacent adsorbed particles ('adatoms'). In the simple theory, the rate of evaporation of adatoms from a surface is $\nu_1\theta$, where θ is the fraction of the surface covered and ν_1 a constant. If atoms condense only on uncovered parts, the rate of condensation is $\alpha_0\mu(1-\theta)$, where α_0 is constant, measuring the efficiency of condensation on a bare surface, and μ the rate of collision of incident atoms per unit area of surface, given by the kinetic theory:

$$\mu = (2\pi mkT)^{-\frac{1}{2}}p = 2·653 \times 10^{19} p(MT)^{-\frac{1}{2}} \quad . \quad (1)$$

where p = pressure in baryes, k = Boltzmann's constant, m is the mass of an atom, and M the atomic weight of the gas. For steady states the rates of evaporation and condensation are equal, hence

$$\theta = \alpha_0\mu/(\nu_1 + \alpha_0\mu) = \alpha_0\tau\mu/(\sigma_1 + \alpha_0\tau\mu) \quad . \quad (2)$$

where $\tau = \sigma_1/\nu_1$ = average life of an adatom, σ_1 being the number of adatoms per unit area of saturated surface ($\theta = 1$). Equation (2) represents the observed adsorption on plane surfaces with reasonable accuracy in a surprisingly large number of cases.

The vapour pressure of a liquid is given over a wide range of temperature by

$$p = AT^{\gamma}e^{-b/T} \simeq A_0 e^{-b_0/T}. \quad . \quad . \quad (3)$$

Trouton's rule requires that $\gamma = 0$ and A is a universal

constant; Hildebrand's rule that $\gamma = 1$ and A a universal constant. A comparison with experimental data for liquids shows that Hildebrand's rule gives better results than Trouton's, but a rule which gives still better agreement is obtained by putting $\gamma = 1{\cdot}5$, when $\log A_{1\cdot5} = 6{\cdot}37$. The vapour pressures of solids, the vapours of which have rigid molecules, are also given by this equation with $\gamma = 1{\cdot}5$ and $\log A = 6{\cdot}9$, but much larger values of A are obtained if the molecules possess internal degrees of freedom. It is therefore assumed that such molecules in the vapour phase may possess high internal mobility, as though liquid, whilst at lower temperatures they may become rigid, as though solid. Such effects probably do not exist with molecules of vapours of liquids. This part of the paper contains a detailed and valuable analysis of experimental data.

The ratio of the latent heat of fusion to the melting point has high values for large molecules such as stearic acid, increasing roughly in proportion to the number of atoms in the molecule, and in such cases a large part of the heat of fusion represents an internal heat of fusion of the molecules themselves, which in the solid are rigidly arranged within the lattice, so that the molecule itself is solid, but when the solid melts the molecule also melts.

In considering the evaporation of adsorbed atoms from an adsorbed film containing σ atoms per unit area, the value of τ, the average life of the adatom, being the same for all, the rate of evaporation (atoms cm.$^{-2}$ sec.$^{-1}$) is

$$\nu = \sigma/\tau = \sigma_1\theta/\tau.$$

From (3) in the form

$$p = A_{1\cdot5}T^{\frac{3}{2}}e^{-b/T}$$

where $$b = b_0 - \frac{3}{2}T = \frac{\lambda}{k} - \frac{3}{2}T,$$

λ being the latent heat of evaporation per atom, and (1) in which $\mu = \nu_1 = \sigma_1/\tau$, we find

$$\tau = (2\pi mk)^{\frac{1}{2}}(A_{1\cdot5}T)^{-1}\sigma_1 e^{-b/T},$$

in which it is shown that $A_{1\cdot5} \simeq 8 \times 10^6$, and hence

$$\nu = A_{1\cdot5}(2\pi mk)^{-\frac{1}{2}}\theta T e^{-b/T}, \qquad (4)$$

an equation for the rate of evaporation of atoms or molecules from monatomic films on surfaces which is shown to agree reasonably well with experiment for thorium, oxygen, and cæsium films on tungsten. In (4) the forces of interaction between adatoms are taken into account by the value of b, and since b is in general a function of θ, the value of ν is not proportional to θ except at such low values of θ that b is near the limiting value for $\theta = 0$.

Although the conditions in which adsorbed films more than one molecule thick can be formed are rather unusual, they are discussed. In general, adsorbed molecules on plane homogeneous solids are acted upon by strong forces originating from the underlying solid. The adsorbed molecules thus become polarised and repel one another as dipoles with forces proportional to M^2r^{-4} (M = dipole moment; r = distance), and attractive forces predominate only when two kinds of adsorbed molecules are present which become polarised in opposite senses, as cæsium and oxygen on tungsten or salts on metals, such as mercurous sulphate on mercury. In some cases, however, the forces exerted between solid and adatom are small, as when hydrogen molecules or helium atoms strike a chemically saturated surface such as tungsten covered with adsorbed oxygen. In such cases the average life of the adatom is so small that it does not even reach thermal equilibrium with the solid, so that the accommodation coefficient is much less than unity (0·1 - 0·2).

The equation of state of the two-dimensional gas composing the adsorbed film may be found by the virial method with a repulsive force specified in terms of dipoles:

$$FA = RT + \tfrac{1}{2}\Sigma(rf).$$

A two-dimensional van der Waals equation, in which the long-range forces are now repulsive, takes the form

$$(F - a/A^2)(A - A_1) = RT,$$

in which A is the area containing 1 gm. atom and A_1 in the ordinary derivation considering only first order effects is found to be only half the area actually covered by 1 gm. atom of adatoms. Experimental data for oil films at high surface concentrations show that A_1 corresponds with a close packed film in which the molecules cover the surface completely, and a new theoretical derivation for the case of a high concentration of adatoms confirms this.

The choice of a dipole repulsive force for the virial expression is justified by the experimental result that adsorption of alkali metal atoms occurs strongly only when the electron affinity of the adsorbent metal exceeds the ionising potential of the alkali metal. The positive charge on the adatoms causes a change in contact potential by as much as 3 volts and a corresponding increase in electron emission. It is then shown that it is possible to calculate the moments M as functions of θ. In the case of cæsium on tungsten, these vary from 16 debyes for $\theta = 0$ to 6 debyes for $\theta = 0{\cdot}9$. The electron and positive ion emission rates are then calculated and found to be in agreement with experiment. In the first case, the influence of electron spin is taken into account and Dushman's equation, derived from the Sackur-Tetrode relation, is somewhat modified, although probably within the limits of experimental error.

The results on the evaporation of cæsium films are very different from those predicted by the old formula (2), based on the assumption that there are no repulsions between adatoms, but the general results are in agreement with the new equations.

The effect of inhomogeneity of the adsorbing surface, first predicted by Langmuir and since studied experimentally and theoretically by H. S. Taylor and others, is then considered. The importance of the so-called 'active areas' in determining the catalytic properties of surfaces, even plane surfaces, is well known. It is shown, however, that the calculations lead to the result that the tungsten surface is essentially homogeneous, although they indicate that on about 0·5 per cent of the surface the cæsium atoms are much more firmly bound than the rest. The active spots probably consist of isolated elementary surfaces each capable of holding one adatom.

University and Educational Intelligence

CAMBRIDGE.—The Busk studentship in aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, has been awarded for the year 1932–33 to Mr. Herbert Brian Squire, of Balliol College, Oxford.

LONDON.—The Coal and Corn and Finance Committee of the Common Council of the Corporation of the City of London has recommended the grant of £100,000 towards the new central buildings of the University which are to be erected in Bloomsbury (see NATURE of July 9, p. 49). At Lord Macmillan's suggestion, the gift of the Corporation will be devoted

to the building of the Great Hall. The grant will be payable over a period of ten years, in annual sums of £10,000, commencing on March 25, 1933, and is conditional on the balance of the cost of the Hall being subscribed, and that the Hall shall be identified permanently and prominently with the Corporation. In a letter to the University, the Lord Mayor expressed the hope that the subscriptions towards the balance will help still further to identify the University with the City.

THE University of London has recently issued a prospectus of twelve courses of university extension lectures to be held during the session 1932–33 at various centres in London. The method adopted in such courses is to follow each lecture with a conversational class. Written work will be set, the submission of which will be optional, but regular attendance, etc., will entitle students to enter for an examination at the end of the course, in connexion with which certificates will be awarded by the University. The courses include the following: twenty-four lectures on "The Psychology of Everyday Life", by Prof. Cyril Burt, at Gresham College; ten lectures on "Religion and Science", by the Rev. S. C. Carpenter, at the Kingsway Hall; twenty-four lectures on "Problems of Society and Government", by Mr. A. Barratt Brown, at the Mary Ward Settlement. The first lecture of each course is free. Further information with regard to these courses of lectures can be obtained from the University Extension Registrar, University of London, South Kensington, London, S.W.7.

THE ninety-first session of the School of Pharmacy of the Pharmaceutical Society of Great Britain will open on Oct. 5, when the inaugural sessional address will be delivered by Dr. C. W. Kimmins, formerly chief inspector in the Education Department of the London County Council.

THE Royal Institute of Public Health has recently issued prospectuses of three courses of lectures and lecture-discussions to be held during the coming winter. The Harben lectures will be delivered on Oct. 10, 11, and 12, at 4 P.M., by Prof. Max Neisser, professor of bacteriology and hygiene at the University of Frankfurt-on-Main, on "Some New Investigations regarding Old Bacteriological Problems". A course of eight lectures, to be delivered by various lecturers, will be given on Wednesdays, commencing Oct. 19, on "Preventive Medicine: The Maintenance of Health and the Avoidance of Disease". Six lecture-discussions have also been arranged to take place on Thursdays, commencing Oct. 27, on "Mental Defectiveness as a Medico-Sociological Problem". All the lectures are free. Further information can be obtained from the Secretary, Royal Institute of Public Health, 23 Queen Square, London, W.C.1.

ERRATUM.—In NATURE of Aug. 27, p. 321, in the title of the thesis for the degree of D.Sc. (Engineering) conferred on Mr. C. E. Larard, the word 'their' should read 'other'.

Calendar of Geographical Exploration

Oct. 2, 1788.—Western Pacific Islands

Capt. John Hunter sailed to the Cape via the Cape Horn route. In 1789 he carried out surveys of parts of the coast of New South Wales and reached Norfolk Island, where his ship was wrecked. In March 1791 he sailed for Batavia and discovered the Stewart Isles and the Lord Howe Archipelago, the latter group being the Ontong Java named by Tasman. After passing the Admiralty group, Hunter discovered and named Phillip Island.

Oct. 5, 1876.—Records of an Arctic Winter

The crew of a vessel built and fitted out by a Russian, Sidoroff, who was interested in arctic navigation, began life in winter quarters at the Briochov Islands in the Yenisei delta, lat. 70° 48′ N. Nummelin, who was in charge of the expedition, with four exiles, kept temperature records from day to day and Nordenskiöld records his results in his account of the voyage of the *Vega*. Nummelin's four companions died of scurvy, but three others later joined him. A relief party came from the south on May 11 and tried to dig the vessel from the snow and ice, but it was again buried by a snowstorm. In mid-June the ice began to melt and the waters rose so high that Nummelin, with five men and two dogs and a small stock of food and fuel, had to pass six days perched on the roof of a hut. Night and day the men poled away the blocks of ice which threatened to crush the hut; on June 25 the water subsided and they were able to climb down.

Oct. 6, 1777.—The Orange River

R. J. Gordon and W. Paterson left Cape Town on a journey in which Gordon reached the Vaal. The two men afterwards made several journeys in different directions, which resulted in the survey of the lower course of the Orange River and in great additions to knowledge of the botany of the region. Paterson was particularly interested in natural history and obtained a valuable collection of South African plants.

Oct. 7, 1844.—From East Coast to North in Australia

Dr. Ludwig Leichhardt started from the Condamine River and reached the Gulf of Carpentaria. Leichhardt's aim was to find a route from the east coast of Australia to the north; in this he was successful, reaching Port Victoria in September of the following year. His journey covered 3000 miles, opened up valuable country, and added much to the knowledge of the orography and drainage of the region through which he passed. Leichhardt met his death two years later in an attempt to cross Australia from east to west.

Oct. 8, 1515.—Estuary of the Plate River

Juan Diaz de Solis sailed from the port of Lepe, reached the Bay of Rio de Janeiro on Jan. 1, 1516, and continuing southwards entered the great estuary of the Rio de la Plata. De Solis reached the north of the Parana River, but was there murdered by Guarani Indians. Sebastian Cabot explored the estuary in 1527 and ascended the Parana to the limit of navigation, the Agipe Falls. A Spanish expedition under Pedro de Mendoza landed in the estuary in 1535 and founded the city of Buenos Aires, but the hostility of the Indians caused the settlement to disappear. In 1541, Cabez de Vaca landed on the island of Sta. Catarina, reached the mainland, and by December 1541 arrived at the Iquassu, a tributary of the Parana, and thence took possession of the Parana for Spain. De Vaca rebuilt the port of Buenos Aires, and on a later expedition up the Paraguay reached the marshy country of Xarayes; he had previously explored the northern shores of the Gulf of Mexico (see Calendar for Aug. 10).

Societies and Academies

Cape Town

Royal Society of South Africa, June 15.—**D. Epstein**: The action of histamine on the respiratory passages. A method was described by which the effects of drugs on the isolated trachea and bronchi of small animals can be recorded with a magnification of about two hundred times. Using this method it was found that histamine produces powerful constriction of the trachea and bronchi of the guinea-pig, but has no effect on or relaxes these structures in the cat. As a result of other methods of investigation it was concluded that histamine produces obstruction of the air passages of the guinea-pig by a direct constrictor effect on the musculature of the trachea, bronchi, and probably bronchioles, while in the cat the respiratory obstruction seen with this drug is due to a constriction limited to the bronchioles alone. On the basis of these results, hypotheses have been put forward in an attempt to examine the respiratory reactions seen in anaphylaxis and asthma.—**H. A. Shapiro** and **H. Zwarenstein**: The effects of hypophysectomy and castration on serum calcium in *Xenopus lævis*. The finding of Charles that removal of both lobes of the pituitary leads to a significant drop in serum calcium is confirmed. Spontaneous partial atrophy of the ovaries in vlei females is found to be associated with a significant drop of 24 per cent. Castration of vlei females gives the same fall in serum calcium as double hypophysectomy, that is, about 40 per cent. This result can be detected as early as eleven weeks after the operation. In males a slight rise of 7·6 per cent, which is not significant, is observed after removal of both lobes. Castration leads to a significant drop of 14·6 per cent. It is probable that in females the drop after hypophysectomy is primarily due to ovarian atrophy.—**B. G. Shapiro** and **H. Zwarenstein**: The effect of injections of arginine and histidine on urinary creatinine. Injections of large doses of arginine or of histidine gives a 12-40 per cent increase in urinary creatinine. Alanine has no effect. After injection of Locke's solution as a control the creatinine excretion was unaffected.—**A. J. H. Goodwin**: Some developments in technique during the earlier stone age. It is suggested that the lower palæolithic of Europe presents only the beginning and the end of a single technical development, which is better represented as a complete series in Africa. Further developments are also suggested as being represented by the Mousterian and the Grand Pressigny techniques.

Geneva

Society of Physics and Natural History, June 16.—**R. Wavre**: Newtonian potential and topology. The author raises the question under what conditions two families of bodies can create the same potential in a certain domain, and shows the importance of the topological distribution of the bodies investigated.—**F. Vasilesco** and **R. Wavre**: Simple examples of multiform harmonic functions. This note establishes that any homogeneous spherical cap produces a Newtonian potential which is an element of a multiform harmonic function. The latter allows an infinity of determinations which ramify round the frontier line of the cap. There is no other singularity of the function, except this: the period function admits a pole at the centre of the sphere.—**E. Friedheim**: The respiratory function of the pigment of *Bacillus violaceus*. The author's experiments lead to the conclusion that the pigment of the violet bacillus accelerates respiration by acting as a hydrogen acceptor. It is not yet proved that it acts as a perfect catalyst regenerated during a cyclic process.—**G. Tiercy**: A historical note. The hypothesis of continental translations. The author points out that the hypothesis of continental translations was formulated by Snider in 1858 and by Père Placot in 1668. Without disregarding the value of Wegener's work, M. Tiercy considers that it is inexact to describe the hypothesis in question as Wegener's hypothesis.

Sydney

Linnean Society of New South Wales, April 27.—**Mary E. Fuller**: The larvæ of the Australian sheep blowflies. The following species are described: *Calliphora stygia* Fabr., *C. fallax* Hardy, *C. augur* Fabr., *Lucilia sericata* Mg., *L. cuprina* Wied., *Chrysomyia micropogon* Bigot, *Ch. rufifacies* Macq., *Microcalliphora varipes* Macq., *Sarcophaga* sp., *Peronia rostrata* A.D., *Ophyra nigra* Macq. A key is included by which these species may be recognised in the larval stage.—**J. R. Malloch**: Notes on Australian Diptera. Notes on species of the genera *Calliphora* (of which three species are described as new) and *Onesia* are given. A key is given for the determination of males of species of *Calliphora* related to *C. stygia*.—**H. Womersley**: A preliminary account of the Protura of Australia. A classification of the order is given, followed by descriptions of the Australian species, which consist of four new species of *Acerentulus* and two of *Eosentomon*.—**J. Andrews**: Rainfall reliability in Australia. Rainfall reliability is principally concerned with the amount of rain which might be expected during any season and the degree of probability of obtaining it. These two aspects of reliability are discussed on the basis of annual figures and for the continent of Australia as a whole.—**F. A. Craft**: Geographical studies in the Blue Mountain Tableland. In the Blue Mountain Tableland settlement is almost confined to the main route passing westward from Sydney to the interior, along which towns and villages have grown since the building of the Western Railway. Some of these depend on the tourist traffic, whilst others support mining and industrial populations. The higher tablelands are barren, but the valleys of the Cox and lower Wollondilly Rivers are used for grazing, and restricted bottoms for agriculture.—**W. L. Waterhouse**: On the production in Australia of two new physiological forms of leaf rust of wheat, *Puccinia triticina*. As a result of inoculating plants of *Thalictrum flavum* and *T. dipterocarpon* with a mixture of germinating teleutospores of the forms of *Puccinia triticina* designated 'Australian 1' and 'Australian 2', æcidia were produced. Uredospore cultures from these showed that three physiological forms were present. One was the form 'Australia 1', but the other two have not been previously found. Details of their reactions were determined. These new forms originated on the alternate host plant, most probably as the result of hybridisation of the forms 'Australian 1' and 'Australian 2'.

Vienna

Academy of Sciences, July 7.—**Richard Weiss** and **Alfred Abeles** (with Ernest Knapp): Condensation of $\alpha\alpha'$-diphenyl-$\beta\beta'$-benzofuran with unsaturated compounds. (2) 1 : 4-Diphenylnaphthalene and its derivatives.—**Anton Kailan** and **Paula Ulicny**: Ester-formation in glycerol and ethyl alcohol. The unimolecular velocity constants (k) for the esterification of n-valeric, caproic, caprylic, and i-valeric acids at 25°, catalysed by c molecules of hydrogen chloride per litre, in glycerol with a mean water content of w mol. a litre, are represented by equations of the form $c/k = \alpha + \beta w + \gamma w^{3/2}$. For the esterification of o-, m-, and p-toluic acids by alcoholic hydrogen chloride, the velocity constants are represented by a more complicated

expression; comparison of the results with those given by benzoic acid shows that the methyl group introduced has the greatest retarding effect in the ortho- and the least in the meta-position.—**Ernst Beutel and Artur Kutzelnigg**: (1) The possibility of following the recrystallisation of silver by coloration with iron chloride.—(2) Properties of silver chloride films formed by the action of iron chloride on silver surfaces.—**Alexander Köhler and Hans Leitmeier**: Thermoluminescence in minerals. The luminescence of a large number of minerals heated to 250°-350° on an earthenware or asbestos plate has been examined. The results differ markedly in some respects from those of previous investigators, no luminescence being shown, for example, with sulphides, tinstone, etc.—**A. Schedler**: Magnetic declination in Austria, Bohemia, Moravia, and Silesia. The results of investigations on the earth's magnetism in Central Europe during recent years are used to obtain a general view of the distribution of magnetic declination throughout Austria and parts of Czechoslovakia.—**Wilhelm Kühnelt and Ekkehard Schmid**: Conditions of life at the snow line of the upper Alps.—**Friedrich Querner**: The paraplasmatic inclusions of liver cells in the fluorescence microscope, and the luminous material. When subjected to the action of ultra-violet light of wave-length 4000-3000 A., the liver cells of various vertebrates, including man, exhibit striking fluorescence.—**Adolf Müller and Paul Krauss**: (1) Synthesis of ε-amino-*n*-heptoic acid. This synthesis was realised by the reduction of the phenylhydrazone of ε-keto-*n*-heptoic acid.—(2) 2-Methylhexamethylenimine. The constitution of this compound is confirmed by (*a*) its synthesis from ε-amino-*n*-heptoic acid via the lactam, and (*b*) by oxidative scission of *N*-benzenesulphonyl-2-methylhexamethylenimine to the corresponding derivative of ε-amino-*n*-heptoic acid.—(3) The action of alkali on 6-bromo-*n*-hexylamine and on 7-bromo-*n*-heptylamine. With the bromohexylamine only a small proportion of the 7-membered cyclic hexamethylenimin is formed, and with the bromoheptylamine, the formation of an 8-membered ring is not detectable.—**Georg Koller**: Ramalic acid. It is shown that ramalic acid, reported by Hesse (1861) and Zopf (1897) as occurring in *Ramalina pollinaria*, does not exist.—**Otto Brunner, Hanns Hofer, and Rosa Stein**: Amyrins. (2) Products of dehydrogenation by selenium. Further proof that amyrins belong to the triterpenes is obtained.—**Karl Morsch**: Action of ammonia and amines on the esters of unsaturated acids. (2) The action of ammonia, methylamine, and diethylamine on ethyl cinnamate.—**Herbert Haberlandt**: Microscopic investigation of a Morogoro mineral in incident light.—**Elisabeth Rona**: Evaporation experiments with polonium.—**Adelina Deseyve, Gerhard Kirsch, and Fritz Rieder**: Disintegration of the atom by neutrons. Experiments with a number of elements by the scintillation method are described.—**Marietta Blau and Hertha Wambacher**: Attempts to reveal photographically protons liberated by neutrons. These attempts have not yet been successful.—**H. K. Barrenscheen, Wilhelm Filz, Karl Braun, Konrad Müller, and Sándor Láng**: Chemistry and physiology of the adenosintriphosphoric acids. A constitutional formula is given for the adenosintriphosphoric acid discovered by Lohmann and simultaneously by Fiske and Subbarow.—**Rudolf Wagner**: *Ardisiandra Wettsteinii* n. sp.—**Robert Kremann and Robert Baum**: The galvanic potentials and constitution of gold amalgams. Amalgams containing less than 75 per cent of gold show the mercury potential, and those with higher proportions of gold, the gold potential. Only those poor in mercury are, therefore, resistant; the resistance limit corresponds approximately with the compound Au_3Hg, for which Pabst found a hexagonal lattice structure.—**Franz Griengl and Robert Baum**: Galvanic potentials of ternary gold-tin-mercury alloys. The potential-concentration curves of the three binary systems and of a number of ternary mixtures show that, in the mercury phase, the compounds AuSn and $AuSn_2$ must be dissociated.—**Ludwig Lämmermayer (jun.) and Robert Kremann**: The position of gold in the potential series of the electrolysis of molten alloys. In its alloys with bismuth, antimony, and lead, gold migrates to the cathode, whereas in those with aluminium virtually no displacement of concentration occurs. In the potential series, gold probably stands near to silver.—**Robert Kremann, Max Pestemer, and Paula Bernstein**: Ultra-violet absorption by binary liquid mixtures. (1) The system chloroform-acetone. In these mixtures the maximum of the acetone absorption band is raised appreciably, whilst the chloroform band is only slightly displaced. A faint band, corresponding with the compound of the two solvents, also appears.—**A. Dadieu, K. W. F. Kohlrausch, and A. Pongratz**: Raman effect. (23) Raman spectrum of polysubstituted benzenes. Of the two benzene frequencies, $\Delta v = 1000$ and 1600, the former is absent from the Raman spectra of all chloro-substituted benzene derivatives except the monochloro-, *m*-dichloro-, and *s*-trichloro-compounds. This frequency hence belongs to a form of vibration at which the molecule pulsates and has, not hexagonal, but trigonal symmetry, and either has or can form nodes at the 1-, 3-, and 5-positions; such symmetry must be ascribed to benzoic itself. The frequency $\Delta v = 1600$ is continually displaced to lower values as the loading of the molecule with chlorine increases, and for C_6Cl_6 reaches the value 1510. In this case the vibration is such that the atoms move almost tangentially in the plane of the ring; this vibration must disappear in a five-membered ring, but reappear in naphthalene, assuming the symmetrical form for the latter.—**Hans Lieb and Miloš Mladenović**: α-Elemol and elemonic acid.—**O. Aluta**: Culture experiments with *Arabis hirsuta* (L.) Scopoli.—**Th. Pintner**: Structures in *Tetrarhyncus* heads.—**Herbert Schober**: A highly sensitive photometer.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, **18**, 343-408, May 15).—**G. A. Lebedeff**: Interaction of ruffled and rounded genes of *Drosophila virilis*. The gene for the character ruffled is normally recessive; in presence of the dominant gene for rounded wings, ruffled becomes dominant, producing a new character, roofed, which shows both the original characters in modified form.—**M. Louise Schmuck and Chas. W. Metz**: The maturation divisions and fertilisation in eggs of *Sciara coprophila*, Lint. Sperms in this species receive more than the haploid number of chromosomes; elimination seems to occur during differentiation of soma from germ-line.—**Anne Marie Dubois**: Elimination of chromosomes during cleavage in the eggs of *Sciara* (Diptera).—**B. R. Nebel and Iris J. Trump**: Xenia and metaxenia in apples (2).—**Willem J. Luyten**: Notes on stellar statistics (5). On the use of the first Laplacean error curve.—**John S. Hall**: The application of photoelectric cells sensitive in the infra-red to stellar photometry. Cæsium oxide on silver photocells cooled with 'dry ice' was used. Cooling reduces the current passing when no visible radiation falls on the cell to the limits of sensitivity of the galvanometer used, stabilises the photo-current, and apparently raises the glow potential. In practice the photoelectric current is nearly proportional to the incident light intensity over the range of stellar

magnitudes extending from 3·0 to 6·5 and gives reproducible results.—**G. H. Dieke** and **G. B. Kistiakowsky**: The rotational structure of the ultra-violet absorption bands of formaldehyde. Photographs were taken in the third order of the 40-ft. spectrograph of the Loomis Laboratory, giving a dispersion of 0·4 A. per mm.—**P. S. Crowell**: The ciliation of the oviducts of reptiles. In two lizards examined, there is a tract of cilia in the albumen-secreting region of the oviduct which probably convey sperms up the oviduct.—**S. C. Lind** and **Charles Rosenblum**: The combination of carbon monoxide and oxygen under the influence of radon. Carbon dioxide promotes the reaction, but only about 14·5 per cent of the ionisation is chemically effective. The recoil atom effect and the inverse square of the diameter law were also examined.—**Ernst Cloos**: 'Feather joints' as indicators of the direction of movements on faults, thrusts, joints, and magmatic contacts. These local joints are so named because they are arranged like the barbs of a feather; they frequently appear along boundaries of moved blocks, etc., and their position and direction indicate the nature of the movements which have taken place. Circular impressions were made on wet clay placed on two iron plates resting side by side. On moving one plate, the impressions are deformed, indicating the axis of strain, and tension joints, shear joints, etc., are formed. Parallel effects are observed in the field, suggesting that such laboratory experiments are useful imitations of natural conditions.—**Charles N. Moore**: On certain criteria for Fourier constants of L integrable functions.—**I. A. Barnett** and **David Nathan**: Sphere geometry and the conformal group in function space.—**J. H. Roberts**: Concerning unordered spaces.—**J. Karamata**: Remarks on a theorem of D. V. Widder.

Forthcoming Events

MONDAY, OCT. 3

ROYAL SOCIETY OF ARTS (Special Meeting).—Robert Howden: "The Elimination of Reflections from Glazed Pictures in Galleries", at 3 P.M.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group, jointly with the London Section) (Jubilee Memorial Lecture).—Dr. G. D. Bengough: "The Corrosion of Metals in Salt Solutions and Sea-Water", at 8 P.M.

TUESDAY, OCT. 4

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Autumn Special Meeting).—Dr. H. M. Vernon: "The Measurement, in Relation to Human Comfort, of the Radiation Produced by Various Heating Systems", at 6.45 P.M.

WEDNESDAY, OCT. 5

SOCIETY OF PUBLIC ANALYSTS (Joint Meeting with the Food Group of the Society of Chemical Industry, at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1).—Discussion on "The Changes in Fruit on Storage", at 8 P.M.

FRIDAY, OCT. 7

PHYSICAL SOCIETY (at the Imperial College of Science and Technology, South Kensington).—Dr. J. W. French: "The Manufacture of Optical Glass", at 5 P.M.

Official Publications Received

BRITISH

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1488: Corrosion Fatigue Test on Aluminium Crystal. By Dr. H. J. Grant and D. G. Sopwith. Pp. 30+12 plates. (London: H.M. Stationery Office.) 2*s.* 6*d.* net.

Board of Education. Rules 101 (revised May 1932): Arrangements and Conditions for the Award of National Certificates and Diplomas in Building to Students in Technical Schools and Colleges in England and Wales. Pp 7. (London: H.M. Stationery Office.) 2*d.* net.

Dominion of Canada: National Research Council. Report No. 25: The Drying of Wheat (Second Report). By E. Stansfield and W. H. Cook. Pp. 104+2 plates. (Ottawa: F. A. Acland.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (New Series), No. 7, July. Abstracts Nos. 1179-1351. Pp. 215-250. (London: H.M. Stationery Office.) 1*s.* net.

Geological Survey Department: Tanganyika Territory. Short Paper No. 10: The Kimberlite and Associated Occurrences of the Iramba Plateau. By Dr. E. O. Teale. Pp. ii+10. (Dar es Salaam: Government Printer.) 2*s.*

Colony of the Gambia. The Annual Report of the Department of Agriculture for the Year ended March 31st, 1932. Pp. 18. (Bathurst: Government Printer.) 8*s.*

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 21: Technological Reports on Standard Indian Cottons, 1932. By Dr. Nazir Ahmad. Pp. iv+109. (Bombay.) 2 rupees.

Tanganyika Territory: Department of Agriculture. Annual Report, 1930. Pp. 65. (Dar es Salaam: Government Printer.) 2*s.* 6*d.*

Bulletin of the Academy of Sciences of the United Provinces of Agra and Oudh, Allahabad, India. Vol. 1, 1931–32. Pp. iii+150+42+9 plates. (Allahabad.)

Annals of the Solar Physics Observatory, Cambridge. Vol. 2, Part 2: Stellar Hydrogen Line Contours and their Variation with Temperature and Surface Gravity. By E. G. Williams, under the direction of F. J. M. Stratton. Pp. vi+25-47+1 plate. (Cambridge: At the University Press.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 26: Factors which determine the Nutritive Value (Stock-carrying and Fattening Capacity) of Untreated Natural Pastures. By E. J. Sheehy. Pp. 325-346. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2*s.*

Reports of the Imperial Economic Committee. Twenty-sixth Report: Constitution and Work, 1932. Pp. 16. (London: H.M. Stationery Office.) 6*d.* net.

Board of Trade. An Industrial Survey of the Lancashire Area (excluding Merseyside), made for the Board of Trade by the University of Manchester. Pp. ix+380. (London: H.M. Stationery Office.) 6*s.* net.

The Imperial College of Tropical Agriculture. Prospectus and Register. Pp. 24. (Trinidad, B.W.I., and London.)

The North of Scotland College of Agriculture. Calendar, Session 1932–1933. Pp. viii+120. (Aberdeen.)

FOREIGN

Bericht über den VIII. Internationalen Kongress für wissenschaftliche und angewandte Photographie, Dresden, 1931. Pp. vii+445+2 Tafeln. (Leipzig: Johann Ambrosius Barth.) 30 gold marks.

Report of the Danish Biological Station to the Ministry of Shipping and Fisheries. 37, 1932. By Dr. H. Blegvad. Pp. 94. (Copenhagen: C. A. Reitzel.)

Proceedings of the United States National Museum. Vol. 81, Art. 2: Birds collected in Cuba and Haiti by the Parish-Smithsonian Expedition of 1930. By Alexander Wetmore. (No. 2925.) Pp. 40+7 plates. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Office of Education. Bulletin, 1932, No. 6: The County Superintendent in the United States. By Prof. Julian E. Butterworth. Pp. v+50. (Washington, D.C.: Government Printing Office.)

Division of Fish and Game of California: Bureau of Commercial Fisheries. Fish Bulletin No. 38: The California Shrimp Industry. By Paul Bonnot. Pp. 22. (Terminal, Calif.: California State Fisheries Laboratory.)

Bulletin of the American Museum of Natural History. Vol. 63, Art. 4: The Genus Melipona; the Type Genus of the Meliponidae or Stingless Bees. By Herbert F. Schwarz. Pp. 231-460+10 plates. (New York City.)

Proceedings of the American Philosophical Society. Vol. 71, No. 5. Pp. 225-307+11 plates. (Philadelphia.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 84. The Birds of Honduras with Special Reference to a Collection made in 1930 by John T. Emlen, Jr., and C. Brooke Worth. By Witmer Stone. Pp. 291-342. Zoological Results of the Matto Grosso Expedition to Brazil in 1931. 1: Fresh Water Fishes. By Henry W. Fowler. Pp. 343-377. Notes on Fresh Water Fishes from Central America. By Henry W. Fowler. Pp. 379-385. (Philadelphia.)

Det Kgl. Danske Videnskabernes Selskab. Biologiske Meddelelser. 10, 5: Studier over *Incurvaria koerneriella* Zell. (Lepidoptera, Incurvariidae). By Ad. S. Jensen. Pp. 49. (København: Blanco Lunos Bogtrykkeri A.S.)

U.S. Department of the Interior: Office of Education. Bulletin, 1932, No. 10: Physical Education and Health Education as a part of all General Teacher-Training Curricula. By Marie M. Ready. Pp. v+47. Bulletin, 1931, No. 20: Biennial Survey of Education in the United States, 1928–1930. Chapter 3: Statistics of City School Systems, 1929–1930. Pp. 231. Leaflet No. 42: Education in the Virgin Islands. By Arthur E. Lindborg. Pp. 4. 5 cents. (Washington, D.C.: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. 87, No. 10: Lethal Action of Ultra-Violet Light on a Unicellular Green Alga. By Florence E. Meier. (Publication 3173.) Pp. 11+2 plates. (Washington, D.C.: Smithsonian Institution.)

Cornell University: Agricultural Experiment Station. Bulletin 532: Production and Marketing of Field Beans in New York. By H. N. Young. Pp. 203. Memoir 139: An Analysis of the Characters of the Inflorescence and the Fruiting Habit of some Varieties of Greenhouse Tomatoes. By A. G. P. Bouquet. Pp. 42. Memoir 141: Multiple Correlation Analysis as applied to Farm-Management Research. By Stanley W. Warren. Pp. 37. (Ithaca, N.Y.)

Proceedings of the United States National Museum. Vol. 80, Art. 23: Revision of the Nearctic Ichneumon-Flies belonging to the Genus Macrocentrus. By C. F. W. Muesebeck. (No. 2923.) Pp. 55. (Washington, D.C.: Government Printing Office.)

Forty-seventh Annual Report of the Bureau of American Ethnology, 1929–1930. Pp. vii+1108+61 plates. (Washington, D.C.: Smithsonian Institution.)

Carnegie Institution of Washington. Contributions to Embryology. Vol. 23, Nos. 134-138. Pp. iii+207+27 plates. (Washington, D.C.: Carnegie Institution.)

SATURDAY, OCTOBER 8, 1932

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Ottawa and After

THE Ottawa Conference has been a success: how great a success it will be for posterity to decide. There were many who seriously believed that its failure would inevitably mean the break up of the British Empire. This view, indeed, was frankly stated at Ottawa, and it is a significant fact that almost everyône there was concerned to make every possible sacrifice to prevent such an eventuality. That particular danger, real or imaginary, is past, and there exists instead a definite acceleration of the Empire spirit, which is soon to be translated into action both in the mother country and in the Dominions.

Perhaps—nay, we would rather say definitely—this Ottawa spirit is of even greater value than all the practical concessions and agreements. It is for every Briton to foster and develop it to the advantage of all parts of the Empire. The Dominions are to-day equivalent to full-grown men and are no longer in the stage of infant colonies to be watched over with navy and army and lent a machinery for government: those who have not visited and spent some time in the Dominions fail very largely to understand that they are nearer the realities of life as enforced by climate, by long distances between towns, and by a spirit of democracy and freedom. The standard of living in the Dominions is higher, though their standard of culture may be less, than in England. In short, their habits in many respects are not the same as ours. We cannot change them, and therefore the mother country must study them and sympathise with them if we essay to sell to them our manufactured articles.

The details of the arrangements made at Ottawa between Great Britain and the Dominions have not yet been divulged, but it is known that they include substantially increased British preference by the Dominions on a very large number of articles, sufficient to place us in a most favourable position in competition with foreign nations, together with an amelioration of Customs regulations and the like.

In very general terms it was possible to distinguish at Ottawa between a background of experts and industrial representatives and a foreground of politicians. The former were engaged in surveying fields of industry, in establishing facts, in making contacts, in bringing into being potential agreements up to the point of signature.

They created an atmosphere which might almost be described as scientific in its attitude, and it is not impossible to conceive that had they been given plenary powers many fair and wise and acceptable understandings could have been implemented without difficulty, and that even the points of disagreement, when once tabulated, could have been reduced to a minimum. The political atmosphere was of another kind. The item of bargaining had been introduced, and all those other factors which constitute what is called politics and are responsible for so much of the crazy anomalies of the present world.

It is difficult for people engaged in scientific pursuits to understand why membership of a political party, largely for hereditary reasons, makes the individual resolutely shut his mind to facts or consequences and impels him to work for a traditional policy, without reference to its merits or demerits, its repercussions on himself, his family, his friends or his country, or civilisation at large. The world is in labour: sacrifices are necessary from everyone: old policies have failed: new ones must be investigated. It may even be that the day of the individual has passed. Governments to-day listen only to associations, whether they be large bodies of voters or organised associations representing traders. No one individual or firm can be allowed to sacrifice the community to personal ends. Limitation of personal output as practised by the trade unions has few defenders, but limitation of production has been held up as a solution of the economic crisis, and will be again, though it has been tried and has failed this time. It is not enough to limit production: a check must also be placed on the uncontrolled extension of the capacity to produce. A new invention, a new method of making something results in the erection of a factory to make an article, in spite of the fact that the existing factory or factories are fully able to meet the demand. The new nationalism, one of the worst diseases resulting from the War, has caused every country to engage in manufacture for itself, largely unnecessary, often uneconomic and only existing as the result of tariffs. Hence the destruction of international trade, the cessation of exports, the disturbance of the channels of credit, the upset of exchange, and the inevitable unbalanced budgets.

Reason must prevail if we are to return to normality. There must be some agreement to restrain the erection of new factories or the enlargement of old plants, when abundant up-to-date capacity for production already exists. There are already examples in Great Britain of restricted industries which are half monopolies, and which can only extend at the will of Parliament and after relevant opposition has been heard. Such is the gas industry, which offers continuous and regular employment, with pension privileges, to its staff and workpeople, and yet is technically and commercially abreast of the times. A local gas company is still in the fiercest competition with electricity and oil, but it is spared, however, competition with another gas works in the vicinity which, if allowed, would reduce both factories to fifty per cent load, with evil consequences to half the staff of each, and imperil the economic future of both concerns. A synthetic ammonia works has no such protection against duplication of production, and unreasoning competition, yet the provision of fertilisers is an essential national industry, which should be capable of being stabilised.

We have strayed from the subject of Ottawa, but such ideas as are contained in the above were under discussion there, if only in the background. Canada, Australia and South Africa are determined to have certain manufacturing industries, but before venturing into what are for them new fields of industrial activity, they are prepared to ask the question—Is it economic? It is here that the mother country has an opportunity, if we are willing to profit by the spirit of co-operation with our fellow Britons.

There are factories enough in England: the Dominions will give us ample preference for their manufactures. It remains to get together to ascertain the needs of the Dominions, satisfy them as to price, quality, time of delivery—above all, give to them, the buyers, all that is understood in the term 'sales service', which is a word scarcely known in its true sense in Great Britain but which is the key to commercial success across the seven seas. Only in this way can we prevent in the future the erection of unnecessary new factories within the Empire, though at the same time we must take care at home, through our trade organisations or, failing them, our Government, that unnecessary factories are not built here either. The day has come when the industrial worker can and will claim some measure of stability in his employment and not allow the industry which supports him to be at the mercy of the adventurer or the foreigner.

The Dominions are alive to the need for education—schools, universities, training colleges, research institutions exist, if anything, ahead of the needs of the population, and it is partly the attractions of an outdoor life in a superior climate which retard the spread of higher culture in home life. What the Dominions need more than anything else if they would have a real regard for the future is to attract and retain the very best first class men possible for their university professorships. Many such men have been there in the past and some are there at present, but there is need and room for more. The Dominions are but sparsely populated with picked men and women; they must pick their leaders too, and they can afford none but the best.

Biological Teaching

(1) *Fundamentals of Biology*. By J. W. Stork and L. P. W. Renouf. Pp. xv + 448. (London: John Murray, 1932.) 6*s*.
(2) *Biology for Medical Students*. By C. C. Hentschel and Dr. W. R. Ivimey Cook. Pp. xii + 618. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 18*s*. net.
(3) *Animal Biology*. By Prof. Lorande Loss Woodruff. Pp. xii + 513. (New York: The Macmillan Co., 1932.) 18*s*. net.
(4) *Invertebrate Zoology*. By Prof. Harley Jones Van Cleave. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. xiv + 282. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 18*s*. net.
(5) *A Textbook of Embryology*. By Prof. Mary T. Harman. Pp. 476. (London: Henry Kimpton, 1932.) 18*s*. net.
(6) *The Essentials of Biology*. By Prof. James Johnstone. Pp. xv + 328. (London: Edward Arnold and Co., 1932.) 16*s*. net.

IT is not many years since biology teaching in schools, with very few exceptions, was practically confined to the top form and then was only provided for boys who intended to become medical men. Possibly a little nature study or even botany was taught in the lower school but anything in the nature of a continuous course in natural science throughout the school such as has been planned for mathematics or the literary subjects was not thought of. Even now a course of science in which biology plays a part commensurate with its importance to man is a dream of the future. However, a change has come over the scene, and an indication of it is the fact that all the university examining bodies, in deference to a popular demand, have provided syllabuses in biology for the School Certificate examination.

This is a step in the right direction. All the hard words which are uttered against examinations do not obscure the reason for which they exist, namely to afford some indication that candidates are acquiring sound knowledge and a broad view of their subject; and the syllabus for this examination is drawn up with this end in view. The syllabuses for School Certificate biology are all modifications of the 'type system'; that is, by examining in some detail a number of organisms the essential unity of life as well as a little of the diversity of organic beings becomes apparent. So in the book before us—"Fundamentals of Biology" (1)—an account of the anatomy and physiology of a single vertebrate animal, man, and the flowering plant form the central part of the book, and starting from this basis a survey of the animal and plant kingdom is taken, not very full but enough to give some idea of the evolution of the vertebrates and the land plants. While practical work cannot be insisted upon to the same extent as in post-Certificate work, it is regarded as important that a knowledge of the type shall be obtained by direct observation, and this involves, at any rate, an inspection of dissections of animal types (the frog, the earthworm and the cockroach) which have been made for the class by the teacher. Also a knowledge of the functions of organs is fostered by encouraging the staging of simple physiological experiments in class. Examples of such experiments are cited at the end of the chapters: the development of this side of biology teaching will contribute very largely to its success.

A very elementary introduction to the use of the microscope may be made at this stage. The study of *Amœba* and *Hydra* is prescribed but it must be realised that in many schools there are not enough microscopes for the needs of large classes, and in nearly all, the exigencies of the timetable do not allow enough time for the cultivation of the patience necessary for microscopic work in boys and girls of the Certificate age. Lastly should be mentioned the part which the 'natural history' of animals, or the 'associations' of plants, may play in the early stages of biological education. Little equipment is needed for these branches of study

but a good deal of time outside regular school hours. Unfortunately compulsory games and other occupations claim so much of a boy's leisure that he must be a 'red-hot' enthusiast to pursue the study of field work, and this is why the part of syllabuses which deals with it only appears in examination to have been covered by isolated individuals.

From what has been said it will be seen that the teaching of biology to boys and girls between say fourteen and sixteen years of age is on a period of trial. Though the framers of syllabuses have agreed wholeheartedly to embrace the type system the treatment by the teacher must be very different from that necessary in the case of the post-Certificate student, and for that reason the writing of a textbook by an author who has already had experience is exceedingly welcome. Mr. Stork is a master at Charterhouse, where under O. H. Latter so much spadework in the service of biological teaching has been done. The result of his collaboration with Prof. Renouf is a very useful book which contains, besides the clear exposition of the main theme, admirably illustrated by drawings which are largely new, a number of appendixes. Of these, one contains a number of very elementary facts about chemistry and physics which may be useful to beginners in science, a second deals with such practical things as the source of supply of material for classes and the making up of various solutions, and a third gives a number of questions which have been set in School Certificate and Matriculation examinations. In conclusion, one criticism may be perhaps made—that the book might be a little shorter and less packed with fact, with advantage to most students.

(2) The general character of the next examinations in biology, namely, those for the Higher Certificate and the First M.B., is the same for all the examining bodies. The student deals with a larger series of types with more or less thoroughness. What is, however, a desperate affair for the schoolmaster, who has in his class candidates who are going to several universities and medical schools, are the minor variations in the syllabuses, especially where types are concerned. It is earnestly to be desired that the English examining bodies at least should agree upon a list of identical animal and plant types, nor could such an agreement possibly interfere with the general efficiency of the examination. Thus "Biology for Medical Students" is written for the examinations of the University of London and the Conjoint Board. There are so many excellent textbooks which cover almost the same field, that a newcomer must expect critical examination. The authors point out that in most cases separate textbooks in zoology and in botany are recommended at this stage, a division which is also seen in the teaching of biology in separate zoological and botanical departments. However, the duplication of teaching becomes increasingly difficult to avoid, and probably the best that can be hoped for is for botanists and zoologists to collaborate as closely as in the present case. This book has much to recommend it. The descriptions are clear and the illustrations are excellent, particularly in the botanical part where many microphotographs have been utilised. There is a very good section on embryology, concise and yet comprehensive. Still there is nothing very distinctive about the method of treatment while recent research does not always receive its due meed. In *Paramecium*, for example, the rôle of the trichocysts is quite other than that suggested here, and surely the assumption that the contractile vacuole is a mechanism directly concerned with the rate of katabolism has no foundation in experiment. It has often been pointed out, on the other hand, that it is primarily an organ regulating osmotic pressure.

(3) Prof. Woodruff's "Animal Biology" is a version of his well-established textbook, "The Foundations of Biology", designed "for courses in animal biology and general zoology in which plants are considered only incidentally in their relations with animals". It deals with general biology and so must be read with a book which supplies "the details of morphology and physiology of selected types as well as direction for their study in the laboratory". It is in fact the complement of the last-mentioned book. It has many excellent points. The reviewer, however, cannot help thinking that the survey of comparative anatomy and the morphological distinctions of the animal groups is too superficial even at this stage. The sections on development, inheritance and organic adaptation are, however, admirable.

(4) Prof. Van Cleave in his "Invertebrate Zoology" demonstrates very clearly how difficult it is in a book of 280 pages to give an adequate idea of the comparative morphology and relationships of the various 'invertebrate' groups. To take the Coelenterata as an example, while there is a formidable classification at the end of the chapter no clear idea of the difference between polyp and

medusa is given, of the methods of skeleton formation throughout the phylum or even the structure of the threadcell. The reviewer can find little to recommend this book.

(5) There is no doubt as to the importance of including embryology in a general biological course. A general knowledge of the development of the frog and the chick at least ought to be obtained by zoological students, the foundations being laid in the Higher Certificate or First M.B. part of the course and built upon during work for the university degree. Prof. Mary Harman in her "Textbook of Embryology" has written a handy volume, well planned and carried out, and full of useful detail. It deals principally with mammalian embryology and especially human development and should be of value as a book of reference to zoological students. It is, however, rather surprising to learn that the author is accustomed to use the material of this book in her lectures to students in home economics and physical education and "those taking embryology as a cultural subject".

(6) Prof. Johnstone's remarkable analysis of biological data and theory is a book of a very different category from those which have been mentioned above. The field which is surveyed is so vast and the survey is so concisely worded that a student who attempts to use it must have a good deal of previous knowledge, and certainly have experienced some of the "discipline of practical laboratory work on animal types". The 'non-professional' reader could scarcely be satisfied by the meagre summary account of animal morphology which is given. But for a thoughtful undergraduate who wants to take stock of his knowledge of zoology and the place which the science occupies amongst its sisters we cannot too strongly recommend this lucid statement of progress, which contains compressed into less than 300 pages a discussion of zoology in all its bearings. Prof. Johnstone's own points of view with regard to biological theory are indicated in the introduction. "Not only the 'Weismannism' of a former generation, but also the 'Morganism' of to-day have proved unsatisfactory." His hopes for the future are expressed there likewise. "A survey of biological science gives us certain indications that its growing point, at present, is in biochemistry and that this growth of significant theoretical knowledge will be accelerated when it will have been possible to press new physical results into the service of biology."

History of Public Health

(1) *Towards National Health: or Health and Hygiene in England from Roman to Victorian Times.* By J. Anthony Delmege. Pp. xiv + 234. (London: William Heinemann [Medical Books] Ltd., 1931.) 21*s*. net.

(2) *Devils, Drugs and Doctors: the Story of the Science of Healing from Medicine-Man to Doctor.* By Prof. Howard W. Haggard. Pp. xxii + 405 + 16 plates. (London: William Heinemann [Medical Books] Ltd., 1931.) 21*s*. net.

HERE are two attractively written and generously illustrated volumes by an Englishman and an American respectively, which form an excellent introduction to the history of medicine in general and of public health in particular.

(1) Dr. Delmege sets out to trace the development of those factors which influence most directly communal health, and surveys those changes in scientific knowledge which have brought about the formation of sound hygienic principles and their practical application to our national life. His work is divided into six chapters dealing respectively with hygiene in the early civilisations, the Dark Ages and the Middle Ages, the sixteenth, seventeenth and eighteenth centuries, and the period 1800–75, the date of the passing of the great Public Health Act.

In his first chapter Dr. Delmege gives a short survey of public health in ancient Crete, Egypt, Palestine, Greece, Rome and Roman Britain. In spite of the baneful effect of medieval Christianity on hygiene, the Dark Ages, by way of compensation, are shown to be responsible for the erection of hospitals, homes for the aged, orphanages and foundling homes, and the establishment of nursing confraternities. In the sixteenth century the State relief of pauperism, which had hitherto been left to private charity, began to develop in Britain, and more attention was paid to personal hygiene, especially by the upper classes, but the sanitary condition of the streets in London and the other large towns was deplorable.

In the seventeenth century urban conditions still remained very largely medieval, but certain diseases such as plague and leprosy which had been prevalent in the Middle Ages, died out, and syphilis was no longer epidemic. Smallpox, however, was assuming an epidemic form and outbreaks of scarlet fever and measles were occurring.

In spite of peace and general prosperity during the eighteenth century, the health of the people

was bad during the first fifty years, but afterwards showed considerable improvement as the result of better urban sanitation and vigorous efforts to prevent the spread of typhus fever as well as attention to maternity and child welfare. Owing to widespread scarcity and poverty, the social conditions of the first half of the nineteenth century were by no means favourable to health and sanitary reform, but thanks to the work of Shaftesbury, Chadwick, Southwood, Smith, John Simon and others, important reforms in public health including the training of nurses, inaugurated by Florence Nightingale, were introduced.

The diseases prevalent in each of these periods are noted, and a description of each is given in an appendix for the benefit of the lay reader. Another appendix contains a table showing the dates of the principal events in the history of hygiene from the third to the nineteenth centuries.

The text is accompanied by contemporary illustrations of various buildings connected with sanitation such as hospitals, dwelling houses of different types, sewers, aqueducts and baths, and portraits of eminent physicians and sanitary reformers.

(2) Dr. Haggard's work, the unconventional and lively character of which is indicated by its title, is divided into six parts. Part I, which is entitled "The Conquest of Death at Birth", deals with the progress of midwifery throughout the ages, with illustrations of childbirth in ancient Greece and Rome, the Middle Ages and savage tribes, the story of the midwifery forceps, and the campaign against puerperal fever. Part 2, which is devoted to the history of anæsthesia, contains an account of the discoveries in this field of Sir Humphry Davy, Horace Wells, William Morton and Sir James Young Simpson.

Part 3, in which the progress of surgery from the earliest times until the present day is considered, is divided into two chapters, the first dealing with the study of anatomy and particularly the difficulty in obtaining bodies for dissection, and the second with the work of Ambroise Paré, the introduction of the trained nurse, and the change in surgery caused by the discoveries of Pasteur and Lister.

Part 4, which is entitled "The Passing of Plague and Pestilence", consists of four chapters, the first of which contains the history of the Black Death, the second deals with smallpox and cholera, the third with syphilis and the fourth with the problem of prostitution.

Part 5 contains five chapters dealing with various modes of treatment of diseases including not only scientific methods such as those of Pinel, Pasteur, Behring and Ehrlich, but also different forms of quackery and faith-healing from the earliest times until the present day. In Part 6 the debt which civilisation owes to medicine is illustrated by numerous striking examples.

As in Dr. Delmege's work the text is freely interspersed with numerous well chosen contemporary illustrations.

French Colonial Ethnology

(1) *Notes d'Ethnologie Néo-Calédonienne.* Par Maurice Leenhardt. Pp. ix + 340 + 36 planches. 120 francs.

(2) *Documents Néo-Calédoniens.* Par Maurice Leenhardt. Pp. iv + 514. 125 francs.

(3) *Les Tribus du Rameau Lobi.* Par Prof. Henri Labouret. Pp. vii + 510 + 31 planches. 150 francs.

Université de Paris : Travaux et Mémoires de l'Institut d' Ethnologie. Tomes 8, 9 et 15. (Paris : Institut d'Ethnologie, 1930, 1931.)

ATTENTION has been directed from time to time in the columns of NATURE to the excellent work on matters of ethnological interest which is being done through its publications by the Institut d'Ethnologie of Paris. The works here under notice deal, on rather broader lines than the publications hitherto noticed, with peoples in two widely separated areas of the French colonial possessions.

(1) In "Notes d'Ethnologie Néo-Calédonienne", the author, a member of the Evangelical Mission of Paris who has lived in New Caledonia for twenty-five years, gives a great deal of valuable and welcome information relating to the sociology and religion of the people. Attention may be directed in particular to his account of the *pilou pilou*, the most important ceremony in the life of the people, involving preparations lasting more than three years, which has not hitherto been recorded in such detail as it is here. Other matters with which the author deals at length are the houses, currency, warfare, initiation, totemism, in which the totem of the mother is all-important and that of the father has no part, magic and the gods.

(2) M. Maurice Leenhardt follows up his study of the customs of the New Caledonians with a

collection of traditions and folk-tales. The original text is given with an interlinear translation and a free translation at the foot of each page. The author has annotated the tales fully with notes which expound the text where necessary and explain the allusions. The value of these annotations is considerable as these tales, more than most, contain allusions which would escape the notice of all but those who have a close acquaintance with custom and practice, as well as mode of thought. The author points out that it is an indication of the growing decay of tradition that in the later narrations, the teller of the tale inserts explanations of obscure expressions for the benefit of the younger generation.

Among these tales, those which the author groups as a lizard-totem cycle seem to belong to a remoter stratum of tradition; while those dealing with matrimonial infelicities, with the aid of the author's notes, throw some interesting sidelights on native mentality, such as, for example, in the resort to suicide as a method of retaliation through the spirit thus disembodied. The attitude of mind attributed to the wife who resents the adultery of her husband on the ground that he might thereby do harm to the ancestral element in her body is significant.

(3) In this volume M. Labouret has embodied the results of eleven years of observation among the Lobi, which began with his appointment in charge of the administrative district of Diébougou in French West Africa. It is a record of exceptional value, for as the author explains in describing his method of working among the natives, a great part of the material is recorded virtually by the natives themselves.

M. Labouret has been very thorough in the range of his observations, for there would appear to be very little in the life of the peoples that he has not covered. He begins with their history and then proceeds to the technology, arts, the social organisation, economics, law and morality, religion and magic. He confines himself, in the main, to a record of fact, without any attempt at cultural analysis; but he suggests tentatively that the Lobi, who live on the upper waters of the Volta in the south of the Cercle de Gaoua, may be a part of the great culture area which extends from the Bauchi plateau of Nigeria to Sikasso in the French Sudan. This is a culture of agriculturists, of which the common characteristics are absence of clothing for both sexes, the use of the labret among the women, a special type of rectangular dwelling and a common technique in metal working and pottery making (including a knowledge of the *cire perdue* process in casting), a village organisation, religious and secret societies, the use of poisoned arrows and a knowledge of the bull-roarer. The volume is illustrated by a long series of excellent plates.

Short Reviews

A Manual of Embryology: the Development of the Human Body. By Prof. J. Ernest Frazer. Pp. viii + 486. (London: Baillière, Tindall and Cox, 1931.) 30*s*. net.

FOR a quarter of a century Prof. Frazer has devoted himself to an intensive study of human embryos and from time to time has published brief accounts of special investigations, more especially on organogeny. He has now rendered a great service to anatomists and students of embryology by providing this full report on his life's work. It is a very personal record, for Prof. Frazer does not pretend to review the literature or make references to what others have done.

The interest and value of the book depend on the fact that it is a detailed report of what the author himself has seen in actual human embryos, illustrated by his own drawings. It is a great record of minute and prolonged observation.

So this is Science! By H. F. Ellis. Pp. x + 109. (London: Methuen and Co., Ltd., 1932.) 5*s*. net.

BOTH wit and humour are to be found in the travesties of scientific description included in this book. Mr. Ellis evidently knows something about scientific subjects and people, and is ingenious in presenting them in new and unexpected aspects; such, for example, as his definition of the stratosphere—"Said to be full of balloons hoist with their own Piccard". His clever play with words, and his inversion of ideas, make science laughable rather than ridiculous. Many college magazines have, however, contained contributions in similar style; and some of the Red Lion dinners of the British Association have provided burlesques just as amusing as any to be found in this book. Whether scientific readers will consider the hour's entertainment which it offers to be worth five shillings is another matter

Water Diviners and their Methods. By Henri Mager. Translated from the fourth edition of "*Les Sourciers et leurs Procédés*" by A. H. Bell. Pp. xi + 308 + 8 plates. (London: G. Bell and Sons, Ltd., 1931.) 16*s*. net.

THE origin of the divining rod is lost in antiquity, and man, in his efforts to peer into the unknown, has made use of this device from very early times. Not only has it been employed to locate water, valuable minerals and buried treasure, but also

in some instances to trace wrong-doers as well as to discover and diagnose disease in animals and human beings. In all its forms, it has been the "subject of much acrimonious discussion", as the "scientist has naturally shown an inclination to reject the reality of phenomena which he cannot explain on orthodox lines". It is noteworthy that the author considers he has at last discovered the physical causes of the movements of the rod, and concludes that they "are governed by the laws of electrodynamics as formulated by Ampère in 1820".

Apart from a general looseness of phraseology, the author puts forward what is perhaps the best case possible for the divining rod, and quotes a mass of apparently incontrovertible evidence of the reality of the water diviner's powers. It is, however, when he attempts a technical explanation of the behaviour of the divining rod, and a description of the methods employed, that his arguments become unconvincing.

As an up-to-date exposition of the application of the divining rod in all its forms to the location of water, and a description of the new methods recently introduced by the author, the book is both informative and interesting, but many of the statements and conclusions put forward lack conviction and will not be accepted by the physicist without further evidence.

Die experimentellen und theoretischen Grundlagen der Elektronenbeugung. Von H. Mark und R. Wierl. (*Fortschritte der Chemie, Physik und physikalischen Chemie*, herausgegeben von Prof. Dr. A. Eucken, Band 21, Heft 4.) Pp. iii + 126. (Berlin: Gebrüder Borntraeger, 1931.) 16 gold marks.

THIS monograph is, like others in the same series, an account of the subject which will be of use mainly to research workers in other branches of physics. After a short section on the theoretical basis of electron diffraction experiments, about eighty pages are devoted to the experiments themselves. Many of these will be familiar to readers of NATURE through references to them which have been made at various times in "Research Items" and elsewhere. The authors remind us, by their treatment of the subject, that the fundamental work in electron diffraction is now almost as well established as the methods of using X-rays; this, of course, is only natural, as much of the well-developed technique which had been acquired for X-rays was immediately applicable to the newer problems when they arose. Problems which could not be so treated, as, for example, diffraction by single atoms and by adsorbed films, presented little more difficulty, if any, owing to the present widespread knowledge of good vacuum technique.

There is a bibliography of papers up to April 1931, and the usual indexes. The book is, however, scarcely likely to come into the general use to which its merit would entitle it, as it is unjustifiably expensive for such a small production.

Physikalisches Handwörterbuch. Herausgegeben von Arnold Berliner und Karl Scheel. Zweite Auflage. Pp. vi + 1428. (Berlin: Julius Springer, 1932.) 99·60 gold marks.

IT is difficult to see how there can be a demand for a volume such as this, although it apparently exists, as we have here a second and enlarged edition. It falls between two extremes, and provides information which is too technical to be appreciated without a good knowledge of physics, and yet is not sufficiently detailed to be of much value to, say, an honours degree student. In the latter respect it differs markedly from its nearest equivalent in English, Glazebrook's "Dictionary of Applied Physics", which serves this purpose rather well. The list of contributors is, however, imposing, and promises an accuracy in their respective sections which is borne out by the perusal of a number of articles chosen at random. The articles are also, so far as can be judged in this way, reasonably up to date, and include such relatively new topics as wave-mechanics and Debye's theory of electrolytes. In one connexion it may have a quasi-permanent value—it may serve later on as a concise record of a good deal of the present state of knowledge in physics. The price of the book, although high, is not, one imagines, out of proportion to the labour involved in preparing it, and the binding and printing are, as is usual with Springer's books, all that could be desired.

The Automatic Stabilisation of Ships. By T. W. Chambers. Pp. x + 114 + 8 plates. (London: Chapman and Hall, Ltd., 1931.) 10*s.* 6*d.* net.

THE gyroscope has been applied to many purposes undreamt of by its distinguished inventor and were Foucault to visit the stabiliser-room of the Italian Atlantic liner *Conti di Savoia*, he would not know his own child, and would probably feel much as Faraday did when visiting a great chemical works. That ship of 45,000 tons is being fitted with three separate Sperry gyro-stabilisers, each of which has a wheel 110 tons in weight, which in order to keep the ship steady, will be revolved at 910 revolutions per minute. How the plant is constructed and fitted in the ship and how it is controlled and driven is fully explained in two articles in the *Engineer* for Jan. 8 and 15, 1932. Not long before, the same journal published a series of articles on the stabilisation of ships by means of water chambers and gyroscopes, and it is these articles which have been collected and published in this book.

Mr. Chambers deals clearly with both the theory of the gyroscope and the practical application of gyro-stabilisers and his book will, we believe, find its way into many shipbuilders' drawing offices. The subject is a fascinating one, and is but another example of a purely scientific invention which has been applied successfully to a practical engineering problem. E. C. S.

The Pioneer Work of the Systematist*

By The Right Hon. LORD ROTHSCHILD, F.R.S.

THE inquiry into the secrets of organic Nature may be divided into three categories of questions: (1) what organisms creative forces have produced on earth; (2) how they have produced them; and (3) what is the nature of the creative forces. It was at the time of Linnæus a comparatively simple achievement for one man to have enumerated all the animals then known, his "Systema Naturæ" of 1758 containing altogether fewer than 4300 species. That task is in our days a hundred times more difficult, not only on account of the vast number of species which have poured into collections, are still pouring in and will continue to do so for a long time, but also because research in systematics requires a much deeper knowledge of the morphology and bionomics of the animals classified. At the time of Linnæus and after, when systematics were in their infancy, individual specimens showing marked differences were as a rule diagnosed as representing distinct species, the unit called species being looked upon as essentially a constant.

Experience has now furnished a guiding principle in the facts that similarity does not necessarily mean relationship of the forms under observation, that dissimilarity is not necessarily evidence of specific distinctness, and that variability obtains in every species and every organ; and if these facts are kept in mind by the systematist, the reproach of superficiality often justly levelled at work in taxonomy can be borne with equanimity.

Variability is an essential character of everything alive. The concept of the constant species of former days is replaced by the concept of the flexible species, and the saying that like breeds like requires modifying into the statement that a population breeds a population with the same extent of variability. If like breeds like were being taken literally, we should have to alter it into like breeds unlike. For, strictly speaking, individuals are never alike whatever their relationship to each other. A calculation, for example, of the number of specimens required of the commonest British mouse-flea (*Ctenophthalmus agyrtes*) in order to find among them two absolutely alike in the number and position of the bristles on the body arrives at the amusing figure of many million billions, a figure certainly in excess of that of the whole flea-population of Great Britain, and tantamount to proving that there are no two specimens alike.

In studying the characteristics of each specific unit and drawing up diagnoses for purposes of recognition, the systematist renders service in two quite different spheres of work and thought. Being alone able to identify the species in the difficult group in which he specialises, he assists defensive biology in its task of safeguarding humanity against the ravages of health- or food-destroying organisms. Applied biology can only be a science if based on sound systematics. For example, when the Commission investigating bubonic plague in India had become definitely convinced that the plague was a rat disease transmitted to human beings through the agency of a particular species of rat-flea, no satisfactory explanation could be found why in Colombo and the city of Madras an outbreak of plague did not last long, although rats and rat-fleas abounded. The puzzle was solved when Dr. Hirst took the matter up and sent to my brother the flea material collected in the towns mentioned during a period when there was no plague and again when an outbreak occurred. The examination of the material proved that the flea ordinarily infesting rats at Colombo and at Madras was not (as the Commission had assumed) the plague-flea *Xenopsylla cheopis*, but *X. astia*, a very similar, but different species, which, by experiments, Dr. Hirst proved to be an inefficient carrier of the disease. When during the campaign in Mesopotamia camps became infested with rats, the British Museum could give the reassuring answer to an inquiry that there was no danger of a serious outbreak of plague, because the rat-fleas collected were *X. astia*, none belonging to *X. cheopis*.

The help which the systematist can extend to applied biology, however, is for him only a side-issue or a by-product; he is a student of pure science, devoting his time to the discovery of new species, of new connexions between them and of new facts bearing on the relation between the species and its surroundings, the driving force in this pursuit of knowledge being the irresistible attraction which the subject has for him.

The describing of new species and finding the right place for them in a given scheme of classification and the identifying of species may seem work of an elementary kind, necessary and useful, but nevertheless rather superficial. If systematics ended there, they might satisfy the collector perhaps, but scarcely the scientific mind. But this preliminary work is only a part of systematics. A natural classification is based on blood-relationship, and therefore entails an inquiry into the evolution of the species classified. Systematics change from a static study of form into a dynamic study of evolution. A species is like a book, which must be read critically and in its entirety. Unfortunately the systematist is much handicapped, as in the case of mammals, birds, insects and some other classes he has to be content with the portions of the animal which it is customary to preserve in collections. But even so, the contemplation of the skins and skulls of mammals, of the skins of birds, and of the dried insects reveals to him the

* From the presidential address to Section D (Zoology) of the British Association delivered at York on Sept. 1.

latitude and the kind of variability and variation in the species of which he has adequate material, and enables him to compare results with the biologists who have studied the flexibility of species with the view of ascertaining whether the variability is purely fortuitous or whether there is system in the apparent confusion, many so-called laws of development having been discovered in the course of such inquiries.

Now, according to the experience of the systematist, such laws are rules with exceptions, sometimes the normal and the exceptional balancing each other, and it may be stated in general that the opposite must always be expected to occur. Exceptions have a certain fascination, not only for the writers of novels and plays, which are mostly based on exceptional characters or exceptional situations, but also for the biologist. As exceptions are comparatively rare, it requires large collections or long observation to discover them, and if there is no known exception to a certain rule of development, one has the feeling that it will some day be discovered. Take as an example the gallinaceous birds; among these game-birds are found the most striking instances of sexual dimorphism, the cocks exhibiting an often marvellous display of colours, as in the peacock, pheasants, fowls and others, the females being comparatively inconspicuous. It is therefore somewhat startling to find just in this order a genus in which the colours and behaviour of the sexes are reversed. In most species of the Oriental genus *Turnix*, a kind of quail, the females are larger than the males, bear a much brighter plumage, utter the call-note, fight each other for the possession of a male, and leave it to the male to incubate the eggs and to take care of the young.

Of the two classes of animals which I have studied more particularly, birds and Lepidoptera, the coloration is on the whole more constant in birds within the species at the same locality, apart from differences of sex and age, than in butterflies and moths, and individual di- and polymorphism is decidedly more common in the insects than in birds, but it is by no means absent among the latter. Dark and light phases long known to occur regularly among certain raptorial birds, for example, harriers, have during recent years been discovered to exist also here and there in other groups of birds, where they have formerly generally been described as distinct species. Such a correction had also to be made in the systematics of the American genus *Rhamphocœlus*, where red and yellow forms differing only in colour are now regarded as being individuals of one species, intermediate examples of an orange colour also being known, as well as very exceptional examples, such as the aberration *Rhamphocœlus dunstalli* Rothsch., in which the red and yellow colours extend to parts of the body other than those normally so coloured. The gaily coloured parrots furnish other examples of dichromotism; for example, the parakeet, *Eos fuscata* Blyth, which is a fairly common bird in New Guinea, appears in a red and a yellow form in the same place, both forms being about equally frequent, the red one slightly preponderating, and the lory *Charmosyna stellæ* Meyer, which appears in a black as well as a red form.

Besides colour and pattern, the size and shape of the specimens and their appendages and the structure of the secondary sexual characteristics of many kinds are found to be of great help in species classification, but experience has shown that none can be relied on unreservedly any more than colour or pattern. The comparison of the frequently exaggerated distinctions of the males, such as the horns of stags and beetles, the long forelegs of beetles, the stalked eyes of certain flies, etc., has led to the discovery that the size of these organs is not always proportionate to the size of the body, but that the ratio in the development of such appendages increases disproportionately with the size of the specimens; in a small male of a species of Longicorn beetle the antenna may be a little longer than the body, while in a large specimen of the same species it may be several times longer than the body. Collections bear out this law of growth almost completely, but only almost. The stag-beetles are one of the families that have early directed attention to the remarkable development of their mandibles, which are sometimes so large, and the point of gravity therefore placed so far forward that the specimen has to assume a semi-erect position in order to keep its balance.

Such exceptions from general rules are of great interest, and it is therefore the duty of the systematist who comes across an exception—generally accidentally—fully to record it. Does it not seem evident from the cases mentioned that Nature can break a rule of development, just as Nature has created species and destroyed them? After all, the law is only our deduction based on the organisms we find provided by working methods of Nature we endeavour to discover. Circumstances may arise which interfere with the usual 'routine' of growth. The rule of growth illustrated by the stag-beetles, and corroborated by breeding of plants and animals, leaves no doubt that the characteristics in size and weight of an individual are not inherited and therefore are of no importance in the evolution of species. The test can be made in collections by comparing the closely related species of a genus with each other.

It must be clearly understood that in speaking of the unimportance for evolution of the bulk of individuals and the size of certain appendages, we referred to specimens of the same country, that is, individuals belonging to the same interbreeding population. In comparing the populations of two different countries the question assumes quite another aspect. In the systematics of birds the study of subspecies or geographical races has developed into a fine art. Size and shades of colour furnish the main distinctions between subspecies, and here we observe this important contrast that, while the difference of, say, 6 mm. in the wing-lengths of specimens from the same country is of

no importance, because not inheritable, the difference of 2 mm. between the populations of two countries is an inheritable quantity and therefore qualifies the two populations as being subspecifically distinct from one another. The evolution of the subspecific size-difference evidently starts with a shifting of the *average* size.

In our researches on the swallowtail butterflies we came across a combination of distinctions which is most instructive in an inquiry how the subspecies have come into existence. In a large number of species of butterflies and moths the geographical forms are separated by differences in the structure of the organs of reproduction and in colour and pattern. The important point is this, that the two sets of differences vary independently of each other within each subspecies.

The individual characters of the ancestral specimens do not influence the formation of the new race, only what is inheritable is of importance, and what is non-pathological and therefore adaptable to new and possibly less congenial surroundings.

Systematics and morphology are different expressions for the same kind of research, and I have no doubt that experimental biology will likewise have such a deepening influence on systematics that the superficial gap existing between the two lines of research will disappear too. Knowledge *begins* with the observation of phenomena, not with the experiment. The areas inhabited by the geographical forms of the species we have studied are either strictly separated, as in the case of island forms, or they are contiguous, there being between the areas no gap uninhabitable for the species, such as water would be for a dryland species, or a desert or savannah for a woodland species; or the areas may overlap. What happens when the areas touch or overlap and the geographical forms come in contact with one another? In a critical survey of the birds of Kenya Colony, lately published by Dr. van Someren in the Tring Museum periodical,[1] every now and again the author records the observation that perfectly distinguishable subspecies intergrade in the intermediate district, where the two evidently have interbred and produced an impure population, not strictly distinguishable from, or identical with, either present subspecies. The phenomenon occurs very frequently, as must be expected; for the breaking-up of a species into geographical units cannot at once result in sexual aloofness. This, however, is a point which should be further investigated.

Not all geographical races amalgamate when they come together. Many of them have become so different that they can live side by side, each being an independent community not interbreeding with the other. Sometimes we find both amalgamation and specific distinctness among the forms divided from a parent stock, as is the case in the sister species cat-flea and dog-flea. The home of the genus *Ctenocephalides* to which both belong is Africa. Tropical and South Africa are inhabited by a subspecies with short head, and the Nile countries by one with a long head, the two intergrading in the Sudan and Uganda. From India to the Papuan countries, with the exclusion of Australia, a third race occurs, and in Europe and Central and North Asia the cat-fleas were represented by the flea occurring on dogs and wolves. When the Egyptian house-cat came to Europe, it brought with it the long-headed form of *Ctenocephalides felis* Bouché, which thereby came into contact with the palæarctic shortheaded dog-flea. One might have expected that they would hybridise and amalgamate, but they did not. The morphological differences are but slight, but a physiological barrier had arisen which kept and keep the cat- and dog-fleas as species, although they may occur together on the same individual of the host.

Systematics are not concerned with the study of species and their variations only. The species have to be grouped into genera and then into higher categories, all according to relationship, that is, according to descent. As in the study of subspecies the systematist must enter upon geography, so in the search for the past connexions between genera and families his research becomes linked with the past history of the earth and sometimes throws light on this history. If he can prove that two genera now widely separated geographically are really of common stock, then there must have been a means of communication in former times which is now absent. If I may draw again on my brother's studies for an illustration, we will take the distribution of the queerest-looking fleas as yet discovered, the Australian *Stephanocircus* and the American *Craneopsylla*, in which the anterior portion of the head is divided off as a laterally compressed helmet. They are closely related, and the group originated in South America, where occur several allied genera and a genus connecting the group with more normally built fleas. They are only found in the Andesian countries from Patagonia to Ecuador (possibly occurring farther north), and in a modified form as *Stephanocircus* in Australia, nowhere else. The assumption that there was at one time a bridge between South America and Australia is the only explanation at all satisfactory. This conclusion is supported by another genus (or group of genera), *Parapsyllus*, which is plentifully represented by species in the same Andesian countries (not in eastern Brazil, the Amazons and Guianas), and recurs in one species on the islands in the South Polar Sea and in southern districts of Australia. The distribution of both genera evidently took place from west to east.

Although the systematist is primarily concerned with the organisms as produced by Nature, and not with the creative forces which have evolved them, his researches extend to so many different species that he is bound to collect evidence bearing on those forces and their working. There are, in fact, many questions which can only be answered with the help of extensive systematic collections.

[1] *Nov. Zool.*, 37, 292; 1932.

A New Indian Academy of Sciences

IN the fog of political turmoil in which India has for so long been enshrouded, the remarkable scientific developments which have taken place in recent years have been somewhat overlooked. To those acquainted with the conditions prevailing at the beginning of the century, when scientific research was confined almost solely to the specialist Government departments, such as the Survey of India or the Geological Survey, and to the two veterans, who are still happily with us, Sir J. C. Bose and Sir P. C. Rây, the present conditions must appear remarkable.

The scientific renaissance of India dates from the reorganisation of the universities about twenty years ago following on the report of the Curzon Commission. Prior to this the university colleges were little more than high schools, and even so late as 1910 it was possible to take a degree in physics without undergoing any laboratory instruction. With the introduction of honours courses and the consequential increase of staff, the value of scientific research was gradually recognised, so that at the present time the output of original work from the Indian universities compares not unfavourably with that of the West. An outcome of this development has been the formation of new specialist societies which may all be regarded as the offspring of the Indian analogue of the Royal Society, the Asiatic Society of Bengal, which celebrated its centenary in 1913. This old society, full of vitality as it still is, has the disadvantage that its influence is confined practically to Calcutta and its environs. In 1914 the Indian Science Congress was founded, a peripatetic body modelled on the lines of the British Association. This body met with immediate success as is testified by the large attendance at its meetings and the large number of scientific communications read before it. The Indian Science Congress does not, however, undertake the publication of these communications except in abstract, and a natural nationalist spirit, coupled with the long delay associated with publication in European and American journals, has resulted in the foundation of the Indian Chemical Society and of the *Indian Journal of Physics*.

The most recent development is the formation of the Academy of Sciences of the United Provinces, with its seat at Allahabad. A movement for the creation of an Academy was started by Prof. M. N. Saha in 1929, and advantage was taken of the meeting of the Indian Science Congress in 1930 in Allahabad to discuss the functions of the proposed Academy. As a result of the interest and sympathy shown it was registered in December of that year. The first volume of its *Bulletin* has now been published, and this contains an account of the inaugural meeting held on March 1. The main objects of the Academy, of which Prof. Saha is the first president, are the encouragement of science in its various branches, more especially in the United Provinces, and the publication of the results of scientific research, either in its *Bulletin* or in the form of *Transactions* and *Memoirs*. The membership of the Academy, as in the case of the Asiatic Society of Bengal, is divided into two classes, fellows elected for their scientific eminence, the number being limited to thirty, and ordinary members of whom no special qualifications are required. The successful inauguration of this body is welcome evidence of the increasing value now attached to scientific research in India, but it seems somewhat questionable if the publication of a new journal is desirable.

The first *Bulletin* contains twenty-seven original memoirs and it is divided into the following heads :—mathematics, physics, chemistry, industrial chemistry, zoology, botany and general. Under the last heading there is an interesting paper by Sir C. V. Raman on "Spin of Light". Many of the communications could with equal advantage have appeared in the *Indian Journal of Physics* or in the *Journal of the Indian Chemical Society*, and it seems likely that some of them will be published *in extenso* elsewhere, since they are only short abstracts and are so headed. Time will show if there is a real need for the *Bulletin*, but with so distinguished and energetic a president and with such admirable secretaries as Prof. P. S. MacMahon and Prof. A. C. Banerji, the future success of the Academy seems assured, and there is little doubt that it will do much to stimulate the research spirit in the Universities of Allahabad, Lucknow, Aligarh and Benares.

The Colloid Aspects of Textile Materials

EIGHT years ago, the Faraday Society made an interesting experiment in devoting one of its discussions to "Physical and Physico-Chemical Problems Relating to Textile Fibres". At that time the study of fibres was in its infancy, with an uncertain future, and all workers in the subject owe the Society a debt of gratitude for early encouragement during difficult years. Courageous patronage deserves a rich reward, and this the Society achieved in the outstanding success of the second discussion on "The Colloid Aspects of Textile Materials", which was held in the Chemistry Department of the University of Manchester on Sept. 21–23. The meeting was noteworthy for the number and distinction of its overseas visitors and contributors, among whom were included E. H. Büchner (Amsterdam), E. Elöd (Karlsruhe), R. O. Herzog (Berlin), G. van Iterson (Delft), J. R. Katz (Amsterdam), P. Krais (Dresden), H. Mark (Ludwigshafen), M. Mathieu (Paris),

O. Roehrich (Paris), S. E. Sheppard (Rochester, N.Y.), H. de Witt Smith (New York), H. Staudinger (Freiburg), and J. J. Trillat (Paris).

During the years which have intervened between the two discussions, textile fibres and related substances have been studied by a wide variety of methods, and whereas in 1924 the properties of fibres could be explained only in terms of mechanical analogies, a much closer molecular interpretation of fibre structure has now become possible. It is generally recognised that fibres are constructed from long-chain molecules in which a definite unit is regularly repeated. In the case of cellulose fibres, the macromolecule consists of a chain of glucopyranose units linked through positions 1 and 4, while the corresponding units in the case of protein fibres are -CO-CHR-NH- groups, the constituent α-amino acids being linked in this way to form a long peptide chain possessing side chains which vary in character according to the nature of the protein.

The real existence of such long-chain molecules has, in the case of cellulose, been demonstrated by Haworth using an ingenious application of the methylation technique. If the long molecules are not looped, hydrolysis of methylated cellulose must yield, in addition to trimethyl glucose, a small amount of tetramethyl glucose from the terminal glucose units. The relative proportions of the two compounds gives a measure of the length of the chain and its molecular weight. In the case of cotton cellulose the mean molecular weight was found to lie between 15,000 and 30,000. It is satisfactory to note that Stamm, using Svedberg's ultracentrifugal technique, obtained a value of 40,000, but Haworth's determination acquires exceptional significance because the molecular weight can be referred definitely to a single cellulose chain. By means of the ultracentrifuge, Svedberg has also determined the molecular weight of the monodisperse, soluble proteins and obtained values which were 1, 2, 3 or 6 times 34,500. Similarly, in the case of derivatives such as cellulose acetate, the beautiful technique used by Büchner in measuring osmotic pressure has given values of the order of 35,000 for the mean molecular weight. Herzog pointed out, however, that the cellulose acetate used was probably not homogeneous and in a case which he had examined, the crude product gave fractions varying in molecular weight from 20,000 to 140,000.

The point is important because Staudinger, from viscosity measurements with cellulose solutions, concluded that the molecular weight of cellulose was of the order of 120,000. The validity of his viscosity law for compounds of high molecular weight was the subject of detailed discussion, a point of difficulty being the insistence that the molecules must be regarded as long rigid rods. Evidence for their flexibility was adduced by Adam from the properties of monomolecular films of long-chain compounds on a water surface, and it was further indicated by Sidgwick and Rideal that flexibility of the chains need not invalidate the viscosity law. While some difference of opinion still exists as to the precise magnitude of the molecular weight of the long-chain molecules of animal and vegetable fibres, it is satisfactory that all methods agree in giving a molecular weight of the order of 30,000. That such widely different substances as cellulose and the proteins should have molecular weights of the same order of magnitude seems to suggest the existence of a common determining mechanism.

As regards the structure of the fibres composed of such molecules of high molecular weight, there has been a certain difference of opinion. On one hand, Mark has suggested that the molecules are arranged in bundles to form discrete micelles which are the secondary units of fibre construction. Neale and others see no necessity to postulate anything other than long-chain molecules which crystallise with varying degrees of perfection in the same fibre. Actually, there appears to be no essential difference between the two views, and a possible mode of reconciliation is to be found, as Astbury indicated, in Zwicky's recognition of a mosaic or secondary structure in the more familiar crystals. In the case of animal fibres at least, the real existence of micelles, less permeable to water than the fibre as a whole, has been abundantly demonstrated by swelling experiments which have been developed to give a measure of micellar thickness in good agreement with that derived from X-ray and other evidence. With reagents other than water, the micelle structure may be dispersed, as in the case of wool fibres in acid solution, but removal of acid results in its reappearance.

The swelling of fibres, as suggested by Katz, may therefore be intramicellar, intermicellar or permutoid. In the case of wool, rigidity experiments and X-ray studies have clearly indicated that swelling occurs both by intra- and intermicellar water adsorption, and it was argued from the hysteresis phenomena in Marsh's determinations of the influence of adsorbed water on the electrical conductivity of wool, that intra- and inter-micellar water must function very differently in conductivity measurements. A possible method of discriminating between the two was suggested, based on the fact that the first five per cent of water adsorbed by wool is intramicellar. Similar considerations apply to cellulose, and Miles and Mathieu agree in concluding that nitration of cellulose does not proceed on an impervious micelle, but that it is penetrated by acid and nitrates throughout its whole structure simultaneously.

As regards the existence of micelles in solutions of cellulose and its derivatives, Adam showed that the ethers spread completely on water and if micelles exist in the original solution, cohesion is insufficient to prevent the formation of a monomolecular film. The esters and nitrates, on the other hand, showed incomplete spreading, while cellulose in cuprammonium solution was precipi-

tated and not spread on water. Thus no decision can yet be made as to whether or not the micelles of cellulose retain their existence in solution.

Cohesion within the micelles of the wool fibre was shown to depend partially on salt formation between the acid and basic side linkages of the long chain molecules, as well as cystine linkages which are far more resistant to chemical attack. By analogy with the proteins, Mark was led to hint that the subtle differences between native and treated cellulose might depend on similar cross-linkages between the long-chain molecules of native cellulose, such linkages being opened by subsequent treatment. His hypothesis must be regarded as an extension of the views of Neale, who discriminated between two methods of modifying the properties of cellulose—by reactions which alter the reactivity of the hydroxyl groups associated with the long molecules, and those which modify the properties of cellulose by fission of the glucose chains.

In the case of wool and related fibres, the side linkages which have been identified as salts of arginine and glutamic acid, play an important part in determining the configuration of the long peptide chains. These have been shown by Astbury to be coiled into a series of pseudo-hexagons, whereas the peptide chains of silk are normally in the extended form. Since the side chains of silk are mainly non-reactive, it is reasonable to refer the coiled character of the peptide chains in wool to the endeavour of the more reactive acid and basic side chains to realise a condition of minimum potential energy by salt formation. Actually, a regular transition exists from silk with non-reactive side chains, through wool with salt-forming linkages, to feather which, according to Astbury, consists of long peptide chains bridged across by true peptide linkages. The importance of such side chains in determining the physical and chemical properties of proteins has now been fully recognised. For example, Miss Lloyd emphasised the part played by their length and reactivity in determining the extent of protein hydration and swelling. Similarly the salt linkages of wool are of fundamental importance in dyeing processes, and if Elöd's exhaustive application of the Donnan theory of membrane equilibria to the dyeing of wool with acid dyes is combined with the recognition of salt linkages, a precise interpretation of the mechanism of dyeing is possible. There can therefore be no doubt that the ingenious technique developed by Hughes for the study of protein films on water will prove invaluable as a simple and direct method of determining the properties of the fundamental long-chain protein molecule and its associated side chains.

J. B. SPEAKMAN.

News and Views

The Wren Tercentenary Celebrations

SIR CHRISTOPHER WREN was born at East Knoyle, Wiltshire, on Oct. 20, 1632; and to mark the three hundredth anniversary of his birth a special service will be held in St. Paul's Cathedral on Oct. 20 at 4 P.M., and will be attended by the Lord Mayor and Sheriffs in state, and by representatives of the Royal Society, the Royal Academy, the Royal Institute of British Architects, the London Society, the Wren Society and other bodies. The service will be broadcast. The Dean and Chapter are also arranging an exhibition of portraits, models, documents, relics, etc., in the Trophy Room in the Cathedral which will be opened by Sir F. G. Hopkins on Oct. 10, and will be open to the public from Oct. 16 until Nov. 12 at 11 A.M. to 4 P.M. Though it was the rebuilding of the City of London after the Great Fire of 1666, which gave Wren a unique opportunity of displaying his genius as an architect, he had even before then designed the Pembroke College Chapel, Cambridge, and the Sheldonian Theatre, Oxford. His plans for rebuilding the City of London with a series of streets crossing each other at right angles, it is true were not adopted, but he was responsible not only for the design of St. Paul's Cathedral but also for the plans of some fifty churches, besides the Royal Exchange, the Custom House, Chelsea Hospital, Hampton Court, Greenwich Observatory and Buckingham Palace. The first stone of St. Paul's was laid on June 21, 1675, and the last stone set in 1710, thirteen years before Wren's death, which occurred on Feb. 25, 1723.

Wren's long life covered a part of the reign of Charles I, the period of the Commonwealth, the reigns of Charles II, James II, William and Mary, Anne, and the first nine years of the reign of George I. With the great social and political movements of the time he had little to do, but he will always be remembered as a distinguished man of science and England's greatest architect. From the days he was taught by Busby at Westminster School and came under the influence of Wilkins at Wadham College, Oxford, he gave evidence that he possessed unusual powers of mind, and at Oxford he quickly took a place among the devotees of science through whose efforts the Royal Society was founded. Like most of his contemporaries he made experiments in many branches of physics, and was particularly noted for his mechanical skill. At the age of twenty-five years he was appointed to succeed Rooke in the chair of astronomy at Gresham College, London, and four years later he succeeded Seth Ward as Savilian professor of astronomy at Oxford. This post he still held when he began his great career as an architect. The Royal Society was indebted to him in many ways. It was he who drew up the preamble to the charter of incorporation granted by Charles II in 1662; in an address in 1664 he urged the members not to flag in their efforts for it should be the aim of the Society to "plant Crabstocks for posterity to graft on", and when deeply engrossed with plans for a dozen churches he yet found time to serve as president. Many tributes to his genius

have been paid, and here it may be recalled that Newton placed him beside Wallis and Huygens as one of the leading geometers of the age.

Sir Philip Magnus, Bt.

THE many friends of that veteran educationist, Sir Philip Magnus, Bt., will be interested to learn that on Oct. 7 he celebrated the ninetieth anniversary of his birth. Sir Philip attended University College School, London (possibly he is now the oldest of its scholars), graduating afterwards at the University of London. He was secretary of the City and Guilds of London Institute from 1880 until 1888, and within this period was a member of the Royal Commission on Technical Instruction. Afterwards, for some thirty years, he was superintendent of the Department of Technology, City and Guilds of London Institute. Long devoted to the interests of the Royal Society of Arts, Sir Philip was elected its chairman of council in November 1927, succeeding Sir Thomas Holland. An inaugural and most comprehensive address delivered in that capacity was entitled, "The Royal Society of Arts: its Services to Trade and Training".

Prof. H. L. Le Chatelier

CONGRATULATIONS are also extended to Prof. Henry Louis Le Chatelier, the distinguished French chemist, who this week (Oct. 8) celebrates his eighty-second birthday. Elected a foreign member of the Royal Society in 1913, the distinction of the Davy Medal was conferred on him in 1916. As the result of prolonged investigation, he introduced the Le Chatelier thermoelectric couple, and inaugurated a new period in the measurement of high temperatures. One of the pioneers of micrometallurgy, he was among the first to provide exact methods in the science of industrial silicates. His scientific work has always been closely related to practical applications. Prof. Le Chatelier is the author of many memoirs and papers in scientific journals.

The Gregorian Reformation of the Calendar

THIS week is the 350th anniversary of the reform of the calendar ordained by Pope Gregory. The day following Oct. 4, 1582, was called Oct. 15. It is not always remembered that, in addition to the calendar changes, greatly improved lunar tables were introduced for the purpose of computing the date of Easter. An article in the *Southwark Record* notes that the necessary calculations were executed by Luigi Giglio (Aloysius Lilius), Ignatius Danti, and Christopher Clavius. It also points out that the ten days stolen from October are now being slowly repaid, as the 'Summer Time' reckoning gives October an additional hour each year.

Lighting of Picture Galleries

MANY visitors to picture galleries must have noticed that pictures are often hung on the walls of most galleries in such a way as largely to defeat the very object for which these expensive institutions exist. It is about 120 years since Prof. Henry in America first directed attention to the need for collaboration between architects and men of science in planning buildings suitable for music and speech. Gradually the inertia of professional conservatism in this matter has been partially overcome; there remain, however, important optical problems relating to the lighting of rooms in which pictures are to be displayed. Here the physicist can help, and already authorities in London are making experiments. At the Tate gallery, for example, may be seen the advantage of hanging pictures on only one wall of a room, and various schemes of artificial lighting are being tried at the National Gallery itself. It is now generally agreed that pictures in London should be glazed if only to keep them clean and free from deleterious gases. But there are other reasons too; experience has shown that enthusiasts cannot refrain sometimes from touching a canvas, and that pins or other things projecting from the headdress of lady visitors to a gallery have been known to scratch the pictures and do incalculable damage. Since it is the practice to hang all pictures flat against the walls, the reflection of those on the opposite wall, as well as that of an observer, frequently renders it very difficult to make out detail in a painting. For example, in Room 25 of the National Gallery, Trafalgar Square, the large equestrian portrait of Charles I reflects well all the other pictures in that room, a good deal of the roof and the large and extremely ugly warming device and seat in front of it.

Reflection from Glazed Pictures

IN directing attention to the question of avoiding reflection from glazed pictures, Mr. Robert Howden has rendered a useful service both to artists and the public. His paper, read before the Royal Society of Arts on Oct. 3, clearly stated the elements and difficulties of the problem, and it is significant that Sir Edwin Lutyens was in the chair. Mr. Howden recommends replacing the usual flat glass by a sheet bent into a parabola. The adaptation of this device to shop fronts has recently been developed by Mr. G. Brown, and the effectiveness of such a scheme may be seen by viewing the interior of a motor show-room at 88 Regent Street, London, through the curved plate glass windows. No reflection of the street can be seen and only the contents of the show-room is visible from without, so that the window itself does not seem to exist. If this could be applied to pictures in public galleries, it would indeed be a boon. But there is the question of cost and the ever-haunting thought that perhaps some other and simpler solution of the problem may not be out of reach. In order to be effective, pictures hung high up would require a different curvature of glass from those on a level with the eye, and then all the varieties of sizes and shapes of canvases or panels would offer further difficulties. Would it not be as well to try first the simple device of tilting the pictures a little forward? Why is that not done in the public galleries? We think this would at least be an improvement on existing conditions and, if sufficiently successful under the usual system of lighting, the walls of new galleries could be built so as to lean a little

inwards. It might be worth while to construct a light wooden framing that would cover one of the smaller walls of the National Gallery, to hang upon it pictures with dark backgrounds and then to tilt the screen forwards and note the improvement in visibility under the conditions of top lighting in use there.

Museum Improvements

Two articles of real value to museum curators appear in the *Museums Journal* for September. The first, by Dr. L. J. Spencer, discusses the artificial lighting of museum cases, and recommends the use of strip lights along the upper portion of the case, and the painting out of shadows cast by solid shelves. The assumption in such a case is that ordinary daylight lighting is ignored. Diagrams illustrate some of the cases of minerals in the British Museum lit by the method described, one tall (10 ft.) case showing a specially neat method of making use of the otherwise useless upper portion, by the fitting of transparent pictures illuminated from behind. In a second article, Mrs. Joan C. Stevens suggests a way of replacing the very expensive jointed figures used (where they can be afforded) for the display of costumes. With a little ingenuity effective figures can be made at a small cost, with cylinders of rabbit netting. The cylinders, head, arms, body, etc., can be 'bent' into shape as desired, and in proper position can be supported by strengthening struts of wire or wood. If the illustrations represent the results of this process, the home-made figures should find a comfortable home in many a museum, impoverished or otherwise.

British Commercial Gas Association

THE British Commercial Gas Association, founded for co-operative publicity effort in the gas industry, held its coming-of-age meeting in Leeds during the past week. Prince George, after seeing something of the manufacture of gas and gas appliances in the city, attended the dinner on Tuesday evening and gave an interesting review of the achievements of the industry. Major Geoffrey Kitson, in his presidential address, set forth further particulars of the present conditions, stating among other things that there are now five million 'slot consumers' on the books of the industry; that £180,000,000 of money and a yearly consumption of 18,000,000 tons of coal, are involved; and that 100,000 workmen are employed. He alluded to the advances being made in new directions, and in the afternoon, Mr. A. W. Smith, general manager and secretary of the Birmingham Gas Department, stated in his paper that authority has been obtained from the Home Office to run a test vehicle on the road with special steel cylinders containing gas at a pressure of 3000 lb. a square inch. It is hoped that gas so supplied may also be used for country houses and farms in districts remote from gas mains.

The executive chairman, Sir Francis Goodenough, at the opening of the Conference, spoke of the difficult days sure to follow upon the completion of the electricity grid, controlled by the Central Electricity Board. He foresees a desperate effort to get business for the grid "backed up more and more from Whitehall". It was in the gas industry that Sir Francis gained his first laurels as an authority on salesmanship and he insisted on the importance of perfecting the commercial side and of practising individual as well as collective enterprise. Major Kitson, who is chairman of the Leeds City Gas Department, urged the importance of gas and electricity, by co-partnership and concentration, setting themselves at once to achieve a national ideal of service in the most economical extraction of the potential heat, light and power from the great reservoir of energy—our sole native source—the coal fields. If the spirit and demeanour exhibited by Major Kitson prevailed more generally it would be a matter for congratulation. Extravagant *ex parte* statements by the advocates of the two agencies where their services overlap are greatly to be deplored, and they appear to be increasing. Among other things it is to be remembered that the exact measurement of the efficiency of heating appliances is still a subject of difficult scientific investigation. It is appropriate to say that in this and other technical problems, the University in the city where the Conference was held has long co-operated in a fruitful way with the Institution of Gas Engineers and that it has a chair of coal gas and fuel industries founded as a memorial to a great gas engineer, the late Sir George Livesey. In this and one or two other university centres in Great Britain, the scientific education of the gas engineer is now seriously taken in hand and is producing a long-needed type of recruit.

International Scientific Investigation of Population Problems

THE first World Population Conference was held under the auspices of the International Union at Geneva in 1928 and the second Conference at London in 1931. The proceedings of these Conferences have been published. In addition, three standing committees organise and to some extent subsidise research (The International Union for the Scientific Investigation of Population Problems: its Foundation, Work, Statutes and Regulations. Pp. 28. London: c/o Royal Geographical Society, 1932). It might perhaps be a matter for debate whether the results so far published justify a new and cumbrous organisation. But it is another matter when we take into account the value of an attempt to look at population problems from an international angle. All population problems have two aspects—a domestic and an international. The problem of emigration is a case in point. It may be that too much importance has been sometimes attributed to population movements, when, for example, war has been traced to over-population. But there can be no doubt that in many subtle ways population movements do affect international relations very profoundly. Thus if the Union can keep international aspects to the front, it will be justified whatever may be the value of the research which it directly advances. It may perhaps be said that in the long run the successful

ordering of world affairs will depend upon the international handling of such matters as emigration and others with which the Union deals, and it may be hoped that the Union will prosper under the chairmanship of Sir Charles Close, who has succeeded Dr. Raymond Pearl in that office.

Greek Earthquake of Sept. 27-28

DURING the night of Sept. 27-28, a severe earthquake occurred in the Chalcidice district of Greece. Seven villages were entirely destroyed, more than 3000 houses were ruined, and 141 persons were killed and 403 wounded. In Salonica, several of the public buildings were damaged. From the brief accounts so far received, the epicentre seems to lie between Salonica and Mount Athos. Montessus, in his "Géographie Séismologique" (p. 253), defines three seismic zones in this part of Greece, near the towns of Salonica, Izvoro and Kavala, respectively, the recent earthquake being probably connected with the second of these zones. The shocks were strongly felt in Bulgaria, in the Strumitza valley, in or near which the great earthquakes of April 14 and 18, 1928, occurred, but the epicentres of these earthquakes lay about eighty miles to the north of the area recently disturbed.

West Indian Hurricane Season of 1932

THE West Indian hurricane season of the present year will rank as one of the notable ones, since two storms of the first magnitude have already been reported. The particulars of the more recent of these that have appeared in the *Times* of Sept. 28 indicate a phenomenon of an intensity very much above the average, the speed of the wind being said to have reached 120 miles an hour at times in Puerto Rico on Sept. 27, where at least two hundred people have been killed. The storm is said to have been even more destructive there even than that of Sept. 13, 1928, and to have been the worst in the island's history. An official figure for the maximum speed of the wind will unfortunately not be available owing to the fact that the anemometer on the roof of the Weather Bureau at San Juan was destroyed with the tower on which it was mounted. The particulars given of the track do not indicate anything very abnormal. Many September storms pass to the south of San Domingo, as did the recent storm; they generally move towards west-north-west. In this case, however, the centre passed near the Virgin Islands and was on Sept. 28 apparently moving directly towards Jamaica, which suggests a nearly due westward motion. Such tracks are more common in August than in September and have generally passed close to the north coast of Yucatan to Mexico, without having begun the 'recurve' to a north-eastward movement characteristic of northern tropical hurricanes, which carries so many West Indian storms into the Gulf States.

Cloudburst near Bakersfield, California

A CLOUDBURST is reported to have occurred late in the night of Oct. 1 near Bakersfield, California, and to have caused water to advance like a tidal wave 40 feet high down a narrow cañon, sweeping away fifteen bridges, destroying railways and overturning locomotives, with considerable loss of life. Bakersfield lies within the American counterpart of the northern Sahara and the subtropical deserts of Arabia and Persia. The disaster must have occurred within or very near to an area with a mean annual rainfall of less than ten inches, which makes it appear at first sight the more remarkable. Cloudbursts are, however, regarded by meteorologists as nothing more than extreme examples of 'instability rainfall' of the thunderstorm type—they are in fact often accompanied by thunder—and their incidence in normally dry regions has therefore nothing very anomalous about it. The disastrous floods at Louth (Lincolnshire) on May 29, 1920, due to an exceptionally severe thunderstorm combined with an unfortunate accidental blockage of the narrow valley down which the water might otherwise have passed with little damage, occurred in one of the driest parts of the British Isles. The extent of the damage is often governed by such accidental circumstances, and it is interesting to note that a fall of rain at Cranwell (Lincolnshire) on July 11 of this year almost exactly equalled the heaviest fall measured in and around Louth on May 29, 1920, and came in a shorter time, without disaster.

Climatic Changes in Central Asia

THE theory that Central Asia, particularly the Tarim basin, furnishes evidence of progressive desiccation during historic times is refuted by Lieut.-Col. R. C. F. Schomberg in a paper on alleged changes of climate in Southern Turkestan in the *Geographical Journal* for August. Lop Nor, he maintains, is not drying up. Its change of level is due to the loss of the Qurug River water. That river changed its course and though its waters reach the lake they do so by a longer course via the Tarim River and so presumably are partly lost on the way. The Qurug is said now to have returned to its old course. Col. Schomberg gives reasons for denying that any of the rivers are drying except where increased cultivation calls for more irrigation water. He lays no value by the so-called evidence of depopulation in a land where the population is always sporadic and insecure. Dust storms, moving sand, and insect pests may easily cause abandonment of peopled sites. He denies that the many dead *toghraqs* or desert poplars necessarily imply want of water. Sometimes they are killed by the rapidly growing tamarisk, sometimes by disease and sometimes even by too much water. The paper is full of valuable arguments bearing on this much-debated problem.

New Antarctic Lands

AFTER about a century's neglect the Enderby Land area of Antarctica was revisited in the summer of 1929-30 by Sir Douglas Mawson in the *Discovery*, of the British, Australian and New Zealand Antarctic Research Expedition, known for convenience as B.A.N.Z.A.R.E. The *Discovery* continued her work

in 1930–31. A map of the numerous discoveries accompanies a paper by Sir Douglas Mawson in the *Geographical Journal* for August. Mawson's map extends from about long. 45° E. to long. 75° E. Along almost the whole of that extent the coast line is now charted, and a number of prominent peaks have been fixed. During roughly the same period the Norwegian vessel *Norvegia* was in the same waters. Their map with less detail is published in a paper by Major G. Isachsen in *Norges Svalbavd og Ishavsundersökelser, Meddelse* Nr. 12. The two maps overlap east of Enderby Land and the names are different. There was, however, an agreement between the two explorers, Sir Douglas Mawson and Captain Riiser-Larsen, made in a meeting in antarctic seas, to regard the meridian of long. 45° E. as roughly dividing their respective spheres of work. The *Discovery* thus limited her work towards the west. It is to be hoped that the confusion of two sets of new names will not be perpetuated.

Scientific Investigations in East Greenland

Good progress is reported in the Danish three-year programme of scientific investigations in East Greenland, which began last year under the direction of Dr. Lauge Koch. The entire expedition comprised 96 members and they had at their disposal two ships, twelve motor-boats and two aeroplanes. Twenty-six members of the expedition are spending the winter in Greenland: the others returned to Copenhagen on Feb. 19. According to the *Times* of Sept. 21 Dr. Koch announces that already 240,000 square kilometres of the east coast lands between lat. 70° and 77° N. have been surveyed largely with the help of aeroplanes. Important geological investigations have been carried on around King Oscar and Franz Josef fjords. During the coming winter the chief bases are to be at Scoresby Sound, Ella Island, Clavering Island and Hochstetter Sound. Each station will be provided with wireless and will serve as a base for seaplane flights as well as ground survey parties. Hydrographical investigations were also carried out in coastal waters and will be continued next summer. Biologists are attached to each field party.

Relevelling of London

The adoption of the Newlyn datum for Ordnance levels in place of the old Liverpool datum involved a change in levels on the Ordnance maps throughout Great Britain. The difference, however, is not constant owing to errors due to imperfections of instruments in the past. In certain areas surface movements may also be responsible. A network of relevelling along twenty-one lines was completed for the London area in March 1932, involving about 2400 bench marks between Hemel Hempstead and Ware on the north, Godstone on the south, Windsor on the west, and Stroud and Chelmsford on the east. The new heights, as well as the old, with the location of the bench marks, are published in advance of the sheets involved in a volume entitled "Relevelling of London, Abstracts of Secondary Lines" (Ordnance Survey 1932, 7*s*. 6*d*.) The difference between the old and new levels appears generally to be about a foot or a little more, the new levels showing the reduction.

Aerial Photography in Map-making

The progress made of late years in topographical surveying by means of aerial photography is strikingly illustrated by a recent report from the Canadian Department of the Interior. The Dominion of Canada with its vast expanse of hyperborean territory, the accessibility of which is rendered extremely difficult by the physical conditions, has proved a splendid field for this modern method of planimetry. Within the last decade, a total area of 402,500 sq. miles has been covered by aerial photography, comprising 125,000 sq. miles by vertical photographs and 277,500 sq. miles by oblique photographs. Vertical photographs are serviceable for mapping to fairly large scales, or in districts where the country is rough and mountainous, while oblique photographs are more particularly adapted to the exploratory mapping of extensive areas of forest and lakeland of fairly uniform level, such as constitute so large a proportion of northern Canada. Indeed, the oblique method is known as the Canadian method and has been adopted in other countries where the conditions are similar. Its moderate cost, flexibility and the small amount of ground surveying required render it particularly applicable to northern latitudes. During the last ten years, forty map sheets on a scale of four miles to the inch, each covering an area of 5,000–6,500 sq. miles, and three map sheets on a scale of eight miles to the inch, each covering an area roughly four times as great as the 4 mile-inch maps, have been compiled from oblique photographs and published in a National Topographic Series designed to cover eventually the entire area of Canada. Other map sheets have been issued which have been compiled from vertical photographs on larger scales of 1 or 2 miles to the inch.

The Worker's Point of View

The *Human Factor*, vol. 6 No. 8, contains an article by Mr. Louis Katin, a non-apprenticed workman, on "Craft Distinction in the Factory". He demonstrates the importance within the factory of the 'class-feeling' arising over apprenticeship. He explains the worker's prejudice against non-apprenticed companions as due to pride of craft, collective desire to produce better work than any other factory, and consequent dislike of anyone likely to lower general efficiency. He suggests that apprenticeship should be compulsory for all boys leaving school, and possible, without indentures, for those already in the industry. The employer should then make sure that each was taught by a skilled foreman. He cites as difficulties parental disapproval, the length of time involved, and the trade union and employer agreements which unduly limit the number of apprentices in some trades. Yet he thinks that the three parties concerned, consulting with the young people, should find a solution, and with the facilities now afforded by the technical schools the term of apprenticeship might be shortened. Mr. Katin deals convincingly with apprenticeship as a source of disharmony and

social differentiation amongst the workers. It would be interesting to have his opinion on the formidable social hierarchies still to be found in factory and business organisations where apprenticeship is non-existent.

University of the Witwatersrand Fire

WE are glad to learn from Dr. W. Cullen, honorary secretary of the committee formed to restore the library of the University of the Witwatersrand, which was destroyed by fire last Christmas Eve, that satisfactory response has been made to the appeal for funds and books. So far, about 6000 volumes have been despatched to the University and 4000 have still to go. Mr. J. G. Gubbins, whose name is most intimately associated with the 'Africana Collection', has been in England for several months and, as a result of his efforts, a very remarkable collection of historic material connected with South Africa and the Rhodesias has been brought together, which, if circumstances permit, will be exhibited in London this autumn. Lieut.-Commander Tufnell, nephew of Mr. Gubbins, has generously given £500 for some exceedingly rare books and prints which Mr. Gubbins has procured for South Africa. The committee has also received from the Imperial Chemical Industries and its subsidiary companies a very useful donation of 1000 technical and scientific books, and from Lord Melchett the residue of his late father's library, which numbers about four hundred volumes. The University authorities have informed the appeal committee that, though funds are limited, they have decided to start building the new fire-proof library, but will only complete it as the necessary money becomes available.

The Children's Museum in Brooklyn

THIS interesting venture made unprecedented growth and expansion in attendance and activities in 1931. The city's effort to find emergency employment resulted in a welcome temporary addition to the workers, who at one time numbered so many as a hundred. The Museum has three main aims: to give children joy and satisfaction through wholesome activity; to make their education fun; and to give them a consciousness of ability to succeed (Museums of The Brooklyn Institute of Arts and Sciences—Report for the Year 1931). It follows these aims through six divisions of activity—lectures, docentry, loans, boy scouts, mineralogy and the library—and much ingenuity is shown in the methods of laying hold of the childish interests. For example, there is the jig-saw puzzle section, where the puzzles, made in the Museum and related to the exhibits, now number 1000, and were used by 111,727 children. But this ploy demanded a preliminary, and we are told that one coloured woman, Estelle Hall, presided at the washing of 143,577 pairs of [coloured] hands in preparation for assembling puzzles and handling books. The loan division now owns 3812 exhibit cases, many boxed by emergency workers, and during the year these loans made 2,350,260 contacts in the 688 schools which borrowed them.

Extension of the Piccadilly Railway

THE Piccadilly railway originally ran from Hammersmith to Finsbury Park, a distance of 8½ miles through the centre of London. It is now being extended and on completion next year will be 25 miles long and will run from west to north across Greater London. The section from Hammersmith to Acton Town has been running for some weeks. The section from Finsbury Park to Arnos Grove, Southgate, was opened on Sept. 19. Each station with the exception of Arnos Grove is fitted with three escalators. The running of the trains will be notified to passengers by 'describers' showing the destination and the stations at which stops will be made. Although there are twelve different stations, only two connecting wires are required for operating the describers. A 2¾ minutes service will be run to and from Wood Green and a 5½ minutes service to Arnos Grove. This requires 347 trains each way between Wood Green and Hammersmith and made it necessary to provide 275 new cars. The motor cars are equipped with two 240 horsepower motors and the average speed including stops is 25 miles per hour. The electrical energy is obtained on the three phase system from the North Metropolitan Electric Power Supply Company. There are three substations each of which contains three 1500 kilowatt mercury arc rectifiers for converting the power to the direct current system required by the motors. These converters have been made by the British Thomson-Houston Company at Rugby and embody improvements. The line is equipped with automatic signals of the colour light type. These are controlled by track circuits and provided with train stops.

Announcements

IT is announced that Dr. G. C. Anderson, deputy medical secretary of the British Medical Association since 1919, has been appointed medical secretary of the Association in succession to Dr. Alfred Cox, who has retired.

THE following awards were made at the Council meeting of the Royal Aeronautical Society held on Sept. 20: Silver Medal, to Senhor Juan de la Cierva, for his work in connexion with the development of the autogiro; Simms Gold Medal, to Mr. P. Salmon, for his paper and work on catapults; Wakefield Gold Medal, to Mr. L. G. Frise, for his invention of the Frise aileron; R.38 Memorial Prize, to Mr. D. H. Williams and Mr. A. R. Collar for their joint paper on "The Motion of an Airship under Certain Conditions"; Pilcher Memorial Prize, to Mr. Dowsett, for his paper on "The Design of Aeroplane Controls and Control Systems".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant investigator in the Safety in Mines Research Board tenable at Sheffield—The Under-Secretary for Mines, Establishment Branch, Mines Department, Cromwell House, Dean Stanley Street, Millbank, London, S.W.1 (Oct. 22). A biochemist at the Queen's Hospital, Birmingham—The House Governor (Oct. 31).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Fertility of Bees and Vitamin E *

THE question arises as to how in the bee colony certain larvæ are turned into queen bees with extraordinary powers of fecundity while the larvæ which become worker bees normally are sterile. The larvæ start equal, for both queen and worker larvæ are incubated from fertilised eggs, and it is known that a worker larva not more than three days old can be converted into a queen. The suggestion was made by one of us that the larva destined to be a queen bee was given a diet rich in vitamin E which is necessary for fertility, while this vitamin was withheld from the worker larva. The queen larva is fed solely on what is termed 'royal jelly', and when the queen is actively laying (for example, 2000 eggs a day) she is fed by her attendants with the same rich food. Royal jelly is generally accepted as being a secretion from the pharyngeal glands. Worker larvæ are supposed to be fed on royal jelly up to the age of three days when they are weaned on a diet of honey and pollen. According to von Planta (Cowan's "Honey Bee") the larval foods of the bees have the following average composition :

	Albumen. (per cent)	Fatty Substances. (per cent)	Sugar. (per cent)
Queen	45·14	13·55	20·39
Worker			
Under 4 days	53·38	8·38	18·09
Over 4 days	27·87	3·69	44·93
Average	40·62	6·03	31·51

To try to prove whether royal jelly contains an amount of vitamin E which is not present in honey and pollen the following research was undertaken :

Ten young female rats in separate boxes with their first new-born litters were put on a vitamin E-free diet on May 20, 1932. The diet was prepared in the chemical department of British Drug Houses Ltd. and a sufficiency of yeast and cod liver oil was added to keep the rats in good condition and maintain the growth of the young. It was considered that by suckling their young up to the weaning period the mothers would be drained of any store of vitamin E in their bodies; experience has shown that the power of such mothers to breed is lost by the continued feeding on the vitamin E-free diet.

On May 26 mother rats (1 and 2) with their young were given in addition each day about 2 gm. of pollen and honey, while mother rats (3 and 4) and their young received about 2 gm. of honey and pollen a day, the pollen in this case having been first soaked in honey and water for 24 hours. The rats eat the pollen and honey well. On June 27 a supply of royal jelly (queen bee food) collected from colonies about to swarm was available, and mother rats (5, 6 and 7) and their young were given about 0·05 gm. of this jelly in addition to their diet. The royal jelly was put at the back of the tongue of each rat so that it was all swallowed. It was soon realised that the supply of royal jelly would not be adequate for these mothers and their young, so on July 6 the young were removed, and the experiment continued on the mother rats alone; the young from the other mother rats were removed also. Mother rat (9) had killed her litter soon after birth: from July 6 onwards she was given in addition to the vitamin E-free diet about 2 gm. of worker larvæ bee comb, so that she got both the young larvæ and their food to eat. Mother rats (8) and (10) were kept as controls on the vitamin E-free diet without any addition from the hive.

Healthy bucks kept during the night on a normal diet of bread and milk, oats and green food, were from now onwards put to the mothers during the day time; the bucks were changed so that every mother rat had an equal chance of fertilisation.

On July 29 one of the royal jelly rats had a litter of five healthy young. She killed these after two days' suckling. The supply of royal jelly having now given out, on Aug. 3 any addition of honey and pollen was also stopped. A few days later another of the royal jelly rats had a litter of fully developed young, but killed them just after birth. One of the other mother rats which had received an addition of pollen and honey to the diet was found with one immature dead fœtus. All the others having failed to conceive, the experiment was stopped on Aug. 12. Each of the mother rats had increased in weight during the experiment, the royal jelly rats by about 25 gm. each, the others by 30–38 gm. and all were in good condition at the end.

The results show that the daily addition of about 0·05 gm. of royal jelly during one month effected the production of two full term litters among three rats, while the addition daily during two months of 2 gm. a day of honey and pollen or for one month of worker larvæ comb was ineffective, only one immature fœtus being produced among five rats.

It is proposed to continue the research next summer, but the evidence so far appears to justify the conclusion that the bees add vitamin E to royal jelly, on which queens are raised, and withhold it from worker larval food. It is surmised that the vitamin is obtained from pollen and concentrated by the workers possibly in the secretion of their pharyngeal glands, which may produce royal jelly.

These experiments may open up a new avenue of research for bee-keepers and lead to better agreement on matters appertaining to the biology of the honey bee (*Apis mellifica* L.).

The expense of this research has been met by a grant from the Royal Society Government Grant.

LEONARD HILL.
E. F. BURDETT.

* From the laboratory of the London Light and Electrical Clinic.

Constitution of Cholesterol

ON account of the biological importance of the sterols and bile acids, and the relation of the group to vitamins and hormones, particular interest is attached to a knowledge of their molecular structure; and I have recently reviewed the whole of the chemistry of these substances from the point of view of the hypothesis that the carbon skeleton of cholesterol is terpenoid, that is, made up of isoprene units with the extrusion of three carbon atoms from one of the units. It has been found possible to devise a formula which identifies the cholesterol carbon skeleton with that of

the hydrocarbon squalene less three carbon atoms, and it is believed that the new expression offers a satisfactory explanation of the complex relations brought to light by the combined work of Windaus, Wieland, Borsche and many other chemists.

It is suggested that cholesterol may be 2:6:22-trimethyl-(7:24) (8:22) (12:21) (16:20)-tetracyclo-tetracosene-$\Delta^{16:17}$-14-ol and those who care to decipher this rather striking example of organic nomenclature will find a carbon skeleton consisting of two seven-membered rings fused together as are the benzene rings in naphthalene, and again two five-membered rings, one fused to each of the seven rings, as close together as possible but avoiding the formation of any quaternary carbon atom. The secondary alcoholic group and the double bond of cholesterol may be in the usually accepted positions, but it is much better to move both groups one position to the left in the graphic formulæ as usually printed. This is compulsory in the case of all sterol constitutions on the lines of Rosenheim and King[1] and Wieland and Dane[2] and it makes the position of the hydroxyl identical in the sterol and bile acid molecules.

With this altered position of the hydroxyl group the recently proposed formula of Wieland and Dane covers the ground remarkably successfully, except that Wieland's own explanation of the nature of pyrocholoidanic acid cannot be utilised in the new system.

A more complete and yet brief account of this subject has been incorporated in a paper recently communicated to the Chemical Society, but in view of a discussion on the chemistry of the sterols to be opened by Prof. Heilbron at a meeting of the Chemical Society in December, it is thought that the protagonists will appreciate the opportunity to consider in advance the theory now put forward.

R. ROBINSON.

The Dyson Perrins Laboratory,
Oxford.

[1] *Chem. Ind.*, **51**, 464; 1932.
[2] *Z. physiol. Chem.*, **210**, 268; 1932.

Variations of Latitude and Great Earthquakes

MILNE, Cancani and Sieberg have studied the connexion between the latitude variation and earthquakes statistically, by considering the pole shift to strain the earth; the stress called forth by the shift was discussed by Spitaler. Dr. H. Kimura has published, in recent volumes of the *Proceedings of the Imperial Academy, Tokyo*, the results of direct observations of latitude made at the international stations. Plotting the *unsmoothed* mean values of morning and evening groups of observed pairs of stars, I find sharp bends almost simultaneous with many disastrous earthquakes, as given by Prof. A. Imamura in his catalogue. The accompanying diagram (Fig. 1) for the interval 1928–31 illustrates the features—time is marked in dots, great earthquakes by x, minor world-shaking earthquakes by short transverse lines, and deep earthquakes by o.

A glance at the diagram shows that: (1) great earthquakes change the course of pole shift and mostly form angular points: (2) the effect of earthquakes is much felt when the amplitude of latitude variation is small (see the course for 1928): (3) the velocity of the pole changes before and after great earthquakes: (4) curvature is diminished before or after great earthquakes—the path becomes straight or even concave outwards: (5) deep earthquakes, though feebly felt on the surface, sometimes affect the pole shift (see 1928.39 and 1930.14).

Considering that the path before the earthquakes of Khorassan (1929.33) and Newfoundland (1929.89) was nearly straight for about two months, such subterraneous process seems to have been going on for many weeks. It therefore seems likely that there is some foreboding of the earthquake, if daily observation of latitude variation be examined; the change

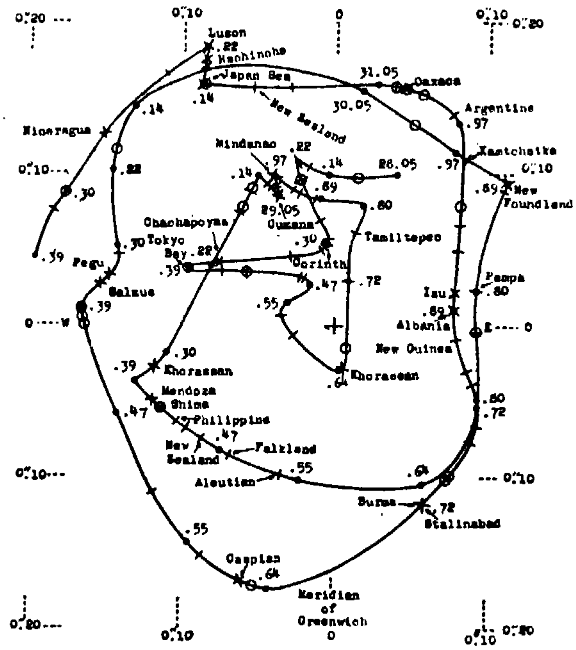

FIG. 1.

of velocity gives another hint to prediction, though the locality cannot be stated.

The readjustment of the principal axes appears sometimes to take place by roughly antipodal earthquakes. There are numerous examples, but the earthquakes of Kansu (1920.96 and 1927.39) and Mendoza (1920.96 and 1927.28), following one after another, are typical examples. If the pole be shifted by earthquakes as here described, the nutations following them are likely to be detected; if the core be liquid, it would act as a damper and make the motion aperiodic. Quantitative discussion can only be made by examining the result of daily observations, of which we have the *Berichte* of the Potsdam Geodetic Institute, but those of recent years are not yet published.

H. NAGAOKA.

Institute of Physical and
Chemical Research,
Tokyo, July 29.

Twisted Trees—Real and Mineral

AMONG the Research Items in NATURE of July 23, 1932, p. 136, reference is made to an interesting paper on twisted trees by Knorr (*J. Heredity*, 1932, **23**, No. 2). From a systematic survey of twisting in various types of trees, the regional distribution of this deformation and the statistical data as to the clockwise and anti-clockwise twisting, Knorr discards light-tropism and influence of winds as possible causes of

this phenomenon. He concludes tree twisting to be genetic in origin, and therefore regards the lumbermen's practice of sparing twisted trees as likely to perpetuate and even enhance the existing evil. To the biologically inclined forester this naturally represents a well-cut and working hypothesis; and yet, I am not convinced.

We can eradicate every vestige of these unfortunate trees and still a new and even more luxurious growth of twisted trees may spring up in the course of time on the ashes of the old.

The solution to this apparent paradox is to be sought in the soil or rather in the fusion of heredity with environment. The tracing of an organism's form and functions to some more primitive type of organic life is basic to our conception of evolution. But unless we can extend this relationship and identify the more fundamental characteristics of living matter with the properties of its constituents—the inorganic world—and thus establish a link between these two spheres, the theory of evolution will remain a wandering derelict.

Minerals constitute an intrinsic component in every organic cell, extending from the iron and sulphur bacteria up to the highest floral and faunal complexities.[1]

The alkaline earth group together with some silicates represent the material which imparts protection, rigidity and form to living matter. This function is the direct outcome of the physical and chemical properties of these substances and therefore we may expect to find in the mineral world some primitive skeleton outline of the organic structural forms.

Actually the salts of calcium, barium and strontium as well as silicates produce arboreal growth such as creeper, bush and tree-like forms.[2]

This stabilising tendency—both in their inorganic condition and in organised matter—is undoubtedly due to the transitory colloidal state of these substances and the peculiar character of osmosis resulting from it.

A more detailed study has shown that this characteristic is even more specific and the growth is typical to each individual radicle or group.

So we find the calcium salts yield upright tree-like formations with a corrugated surface, barium salts give straight growth with a spiral surface, strontium salts form beautiful spirals of a smooth tape-like growth, whilst silicates produce bamboo-like formations.

Again, our experience with the introduction of such groupings as sulphates, carbonates, phosphates and oxalates shows that the increase in constitutional complexity of the radical combinations, especially organo-metallic associations, is followed by a remarkable impetus in arboreal growth and general functional augmentation.

The gradual substitution of these substances by one another in the organism without impairing general metabolism seems to be well established. The silicious matter of the lower organisms gave way to calcium carbonate which in its turn was substituted by calcium phosphate in the higher forms.

Our study of bacterial culture media, general nutrition and such plants as loco-weed, tobacco leaves, etc., shows that this substitution is applicable to barium and possibly strontium.

Considering all these facts it seems to me that tree twisting is primarily due to local soil peculiarities which have in course of time modified the structural constituents of the plants.

Knorr's observation as to regional distribution of tree deformation is as much in support of his genetic idea as the one presented here—his record of a balance in clockwise and anti-clockwise twisting is, however, certainly in full agreement with the view advanced in this letter.

Such an equilibrium seems to be fairly general in periodic formations and is due to boundary influences as well as progress of diffusion in the direction of least resistance. This symmetry was observed in the spiral formation of several inorganic and organic substances.[3]

Whilst emphasising this genetic rôle of mineral matter and its substitution—it is obvious that the cell adaptation to a new or modified environment becomes slower and more difficult with the increase in its differentiation and specialisation; in other words, heredity influences become more accentuated as we ascend the scale of organic life.

Heredity thus appears as a moulding, an incarnate history of successive environmental stages transmitted from the past.

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[1] Copisarow, *Chemical News*, 134, 305, 323, 338; 1927.
[2] Copisarow, *J. Chem. Soc.*, 233; 1927: *Koll. Z.*, 47, 60; 1929.
[3] Copisarow, *Koll. Z.*, 54, 257; 1931.

Human Pathological Conditions Determined by Any One of Several Genes

IT is a striking fact that in many inherited human pathological conditions more than one type of inheritance is found. To quote only two examples, retinitis pigmentosa may be either dominant or recessive, and congenital stationary night blindness may be dominant, recessive, or sex-linked.[1] In a collection of human pedigrees of a condition showing dominant inheritance there is no possibility of determining whether a single dominant factor is involved in all cases, or whether the condition may be determined by any one of several dominant factors. This is also true of sex-linked inheritance, but in the case of a condition which behaves as a recessive, a test is available. The incidence of first-cousin marriages amongst the normal parents of affected offspring can be related to the incidence of the condition in the general population. The formula in use was proposed by Lenz[2] and Dahlberg.[3]

If a be the incidence of cousin marriages in the general population, and p^2 the incidence of the recessive defect in the general population, the proportion of cousin marriages amongst the parents of affected offspring is given by

$$\frac{a}{a + 16p}$$

The value of a may be taken as 0·008 in European communities. Hogben summarises the data on albinism collected by Pearson, Usher and Nettleship.[4] Excluding non-European cases, partial albinism, and uncertain sibships, the data fit the hypothesis of simple recessivity reasonably well. For these cases the percentage of first-cousin marriages amongst the normal parents of albinos is 17. This corresponds to an incidence of albinism in the general population of 1 in 168,000. But, the incidence of albinism in Europe is known to be of the order of 1 in 10,000 to 20,000. It is very difficult to account

for this discrepancy except by postulating that albinism is determined, not by one recessive gene, but by any one of several.

Retinitis pigmentosa presents the same phenomenon. The percentage of cousin marriages in the Usher[5] pedigrees, as summarised by Hogben,[1] is also 17. The incidence of the condition, even excluding cases determined by dominant inheritance, must be much higher than 1 in 168,000. It is to be noted that the exclusion of certain cases by Hogben cannot affect the result. The incidence of consanguineous unions is at least as high for the unselected material. This applies to albinism also. Juvenile amaurotic idiocy may be taken as a third example. In Sjögren's[6] families, the percentage of cousin marriages is 15·3, corresponding to an incidence of the condition in the general population of 1 in 130,000, again an excessively low value.

Alcaptonuria provides an interesting contrast. The data have been recently summarised by Hogben, Worrall and Zieve.[7] The incidence of first cousin marriages is 42 per cent. This corresponds to an incidence of the defect of 1 in 2,330,000. The figure of 42 per cent may be too high as it is based only on those families in which the relationship of the parents is definitely stated, but the authors point out that even if it were not too high, the figure of 1 in 2,000,000 is probably not too small for this very rare condition.

It seems very probable, therefore, that many human defects may be conditioned not only by one of two or three factors differing in their transmission, but also by one of several factors exhibiting the same type of transmission. The crucial test would be provided by the marriage of unrelated affected persons, but such marriages are, unfortunately, very rare.

The reason why it should so frequently happen in human records that the same end result may be due to one of several factors is not difficult to understand. In laboratory material, or in domesticated animals and plants, the observer is usually dealing with one strain, or with a stock in which inbreeding has taken place. In the case of human defects, on the other hand, countless observers all over the world are constantly putting on record a substantial proportion of the rare deformities occurring in a race in which random mating is the rule.

The implications, if the phenomenon is accepted as one of general occurrence, are of considerable theoretical and practical importance, but it is unnecessary to discuss them here. The value of studies on consanguinity is emphasised especially in the case of conditions that are too common for a significant excess to be expected if only one factor were concerned. It is also becoming increasingly evident that an adequate human genetic prognostication demands a close study of the individual family concerned against the background of cases recorded in the literature, these being sifted, classified and analysed by appropriate methods.

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University of Edinburgh,
Aug. 29.

[1] Hogben, *J. Genet.*, 25; 1931.
[2] Lenz, *Münch. Med. Wochen.*, 66; 1919.
[3] Dahlberg, *Hereditas*, 14; 1930.
[4] Pearson, Usher and Nettleship, *Drapers Co. Res. Mem.*, 1–4; 1913.
[5] "Treasury of Human Inheritance", 2; 1922.
[6] Sjögren, *Hereditas*, 14; 1930.
[7] Hogben, Worrall and Zieve, *Proc. Roy. Soc. Edin* 52; 1932.

Evolution of Hormones

IT is clear that the integrative mechanism implied in the word 'hormone' or its synonyms consists of two parts: there are on one hand the cells which elaborate the specific chemical substance, on the other, the cells which respond to the presence of this substance when it is brought to them. The object of this letter is to point out that evidence exists that some at least of these linkages have been established by the evolution of a tissue responsive to a substance already produced within the organism for some other purpose or through some vagary of metabolism.

There are several examples of the apparently useless presence in relatively primitive organisms of chemical substances which in higher groups have acquired a physiological function as hormones. That adrenaline is present in certain annelids[1] is much more certain than that it has any endocrine function in this phylum. The specific substance of the mammalian posterior pituitary which causes contraction of the uterine musculature is represented even in the elasmobranch,[2] though it must be admitted that it is by no means certain that this substance has acquired a natural physiological function even in the mammal, and it is of course possible that it has some unknown function in the fish. A better example, therefore, is the presence of an oestrin in insects,[3] since the occurrence of sharply-delimited gynandromorphism makes it highly improbable that there are functional sex hormones in this class. A converse case is the vestigial survival in the pituitary of the mammal, despite the disappearance of the responsive tissue, of the substance which causes the expansion of amphibian melanophores and teleost erythrophores.[4] Moreover, there are many examples of the extension of responsive tissue in evolution; thus the ventricular muscle of the mammal has developed a sensitiveness to adrenaline which is absent in the reptile.[5] Is it too fanciful to regard the refractoriness of the genital organs of very young female rodents to stimulating hormones,[6] or of the beating heart of the two-day-old chick embryo to adrenaline and acetyl-choline,[7] as instances of phylogenetic recapitulation?

The most striking illustration for the present argument, however, is the demonstration[8] of a substance in the anterior pituitary which stimulates the development of the mammary glands in the guinea-pig and of the crop gland in the pigeon, two analogous but by no means homologous organs, which must have developed separately their responsiveness to this (apparently) single substance.

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Montreal, Canada,
Sept. 8.

[1] J. F. Gaskell, *J. Gen. Physiol.*, 2, 73; 1919.
[2] L. T. Hogben and G. R. de Beer, *Quart. J. Exp. Physiol.*, 15, 163; 1925.
[3] S. Loewe, W. Raudenbusch, H. E. Voss and W. C. van Heurn, *Biochem. Z.*, 244, 347; 1932.
[4] B. Zondek and H. Krohn, *Klin. Wochenschr.*, 11, 405; 1932.
[5] T. R. Elliott, *J. Physiol.*, 32, 401; 1905.
[6] B. P. Wiesner, *J. Physiol.*, 75, 39P; 1932.
[7] C. Markowitz, *Amer. J. Physiol.*, 97, 271; 1931.
[8] O. Riddle, R. W. Bates and S. Dykshorn, *Proc. Soc. Exp. Biol. Med.*, 29 1211; 1932.

Has Physics Discarded Mechanism?

IN his British Association presidential address of 1931, General Smuts pointed out that "the older mechanistic conception of Nature is being modified". This is undeniable; but to what extent does it justify the accompanying statement that "the very basis of mechanism is undermined"? This has been repeated frequently, with applications to psychology, ethics and philosophy that are as obvious as they are debatable.

What then is the meaning of 'wave mechanics' and 'quantum mechanics'? If we define mechanisms as systems, of any kind, in which their constituent parts or factors co-operate definitely, precisely, and in most cases repetitively, in such a way that energy is transmitted, transferred, or transformed, is not some such concept not merely legitimate, but indispensable to physics, as distinct from pure mathematics, which may, or even must, dispense therewith?

To cite specific examples, are not the rotating galaxy, the solar system, crystal oscillators, vibrating atoms, and possibly also electrons and protons, mechanisms in the same sense as a clock is a mechanism? Further, if we regard any series of periodic changes as a wave series, may we not include under 'wave' a swinging pendulum, a water wave, and an electron?

It should be observed that purpose, in any form, is neither implied nor excluded, while the uncertainty principle may express only the limitations of knowledge, not necessarily the character of Nature.

Is not the 'older mechanistic conception' being replaced by the concept of mechanisms which are so much more complex, delicate and precise than earlier models that only mathematical expressions are adequate for their description and explanation? But it does not follow that, because such mechanisms cannot be imaginatively represented, they are therefore non-existent; it simply implies that they are too complicated for imagination to grasp. The advance in theory, then, does not justify the complete discarding of mechanism, as such.

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Aug. 22.

Change of Paramagnetic Susceptibility due to Absorption of Light

WE have already published in NATURE[1] a note giving the results of our observation on the change in susceptibility produced in paramagnetic solutions like that of chromic chloride, etc., due to light absorption. Following the suggestion of S. Kato, we had assumed that the absorption maxima at λ 4300, 6100 in a given solution of chromic chloride were due to the transition of the Cr^{+++}ion from the ^4F to ^4G resp. ^2H state. On the supposition that both in the initial and in the final state the magnetic moment of the ion is due only to the spin moments of the magnetic electrons, such transitions would be accompanied by diminution in the magnetic moment of the ion. We reported that the result of our observation indicated a diminution in the susceptibility of the chromic chloride solution and therefore was in agreement with our theoretical assumptions.

Recently Gorter[2] reports that he has observed a similar diminution of susceptibility in a solution of chromic chloride due to absorption of light, but he finds that this diminution is to be attributed to rise in the temperature of the solution. Since the publication of our letter in NATURE, we have found that the deflection of the bulb containing the chromic chloride solution corresponded to an *increase in its paramagnetic susceptibility* and not to a diminution. A paper containing the results of our investigation was sent about two months ago to the *Zeitschrift für Physik*, where the experimental details will be found. We may mention here that we used a torsion balance of period 3–5 sec., and neutralised the effect of the field on the bulb containing the concentrated solution, by attaching a bismuth ball of suitable size below it. The response to the incident light was almost instantaneous, and after a prolonged exposure the light spot gradually returned to its original position and then moved over to the opposite side. Specchia[3] has also observed this quick increase in magnetic susceptibility due to light absorption.

In using the torsion balance, the bulb has to be placed almost in a position of instability in the inhomogeneous magnetic field, and for each set of observations a new adjustment has to be made. Under such conditions it is difficult to obtain reproducible results. We have, therefore, tried other methods of making this effect measurable. The following one we think will give fairly consistent results. A modified form of the inclined capillary tube arrangement used by Liebknecht and Wills[4] is filled with chromic chloride solution and the meniscus is placed between the pointed poles of an electromagnet. Light from a mercury arc, after passing through an infra-red filter, is focused from the top on the meniscus. Observation of the position of the latter in the magnetic field is made, once when the incident light from the arc is further filtered through a concentrated solution of chromic chloride, and again when this filter is taken off. Deflections of about 1·5 scale divisions of the micrometer scale in the eye-piece of the observing telemicroscope, indicating an increase of susceptibility, were noted.

Since the transitions from the ^4F to the ^2G resp. the ^2H state represent diminution of the spin moment of the ion, the observed increase in susceptibility can only be interpreted as being due to the temporary break down of the l-coupling between the Cr^{+++}ion and the associated water molecules. Some interesting applications of this result are given in another paper which appears in the *Zeitschrift für Physik*.

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Calcutta, Aug. 3.

[1] NATURE, 127, 520, April 4, 1931.
[2] NATURE, 130, 60, July 9, 1932.
[3] Specchia, *Phys. Ber.*, 547; 1932.
[4] Liebknecht and Wills, *Drude's Ann.*, 1, 178; 1900.

Iodine in Cod Liver Oil

THE purpose of this note is to indicate to British workers in the field of endocrine secretions and nutrition certain experimental work which we have thus far withheld from complete publication pending studies which we are now ready to report in detail.

We showed[1] that ferrous iodide mixed with the food would benefit rats on a diet deficient in vitamin A. Later we demonstrated that unsaturated fatty acids were apparently indicated in addition.[2] More recently we have summarised our findings.[3]

Studies made during the past winter and spring in which we induced leg-weakness in chicks by the intravenous injection of anterior pituitary extract, but prevented it in other animals by orally adminis-

tered thyroid extract, have led us to interpret correctly the findings of a poultryman who reported to us the remarkable success secured by him in administering iodine to a number of chicks that had developed leg-weakness on a diet apparently adequate so far as cod liver oil and fish meal were concerned, but containing an excess of wheat. In an extensive report, which will shortly appear in *Endocrinology* (Chidester, Ashworth, Ashworth, and Wiles), we are describing our results, which seem to emphasise the rôle of the iodine in cod liver oil in the prevention of rickets. We suggest that since ergosterol and ultra-violet light may induce excess calcifications and even set up a profound calcium-iodine unbalance, it may be wise to utilise cod liver oil, which we have found it possible to super-iodise and otherwise mineralise in the treatment of certain diseases.[4] Several investigators, including our group, have shown that iodine will prolong the lives of rats that have had an excess of vitamin D.

We have already credited (loc. cit.) Col. McCarrison with his initial emphasis on the iodine-fat balance in nutrition, and consider ourselves fortunate in having been able to point out the rôle of ferrous iodide and unsaturated hydrocarbons and fats in several so-called vitamin deficiencies. We are especially interested at present in the fact that a variety of substances of benefit to the organism can be carried into the cells by cod liver oil. We are attempting to have others repeat our observations and make clinical tests with super-iodised cod liver oil in tuberculosis and the common cold and also to compare the results obtained in leprosy with ordinary chaulmoogra oil, with those secured by iodising it.

If our studies are significant—and we believe that long-continued experimentation makes them so—we have evaluated the rôle of the iodine of cod liver oil in the treatment of nutritional diseases and furnished an explanation of the activity of many iodine-containing medicaments.

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Morgantown, Aug. 29.

[1] Chidester, Eaton and Thomson, *Science*, **36**, 641; 1912.
[2] Chidester, Eaton and Speicher, *Anat. Rec.*, **47**, 304, 1930; Chidester, *Med. Times*, **59**, 138; 1931.
[3] *Science*, **75**, No. 1934, 106; No. 1941, 286—287; *Collecting Net*, **7**, No. 9, 227–230.
[4] Chidester, F. E. "Zoology", D. Van Nostrand Co., New York, 1932.
* Aided by a grant from the Society of Sigma Xi.

Causes of Ionisation in the Upper Atmosphere

SINCE May 1931, I have taken numerous measurements of the virtual reflection height of radio waves 40–140 m. long; at the same time, I have, at different times during the day, determined the short wave limit for vertical reflection in the ionosphere. Some of the principal results which I have obtained are summed up here:

In the E region, by day, the maximum electronic density does not exceed 6×10^5 (electrons per c.c.) in summer, and $3{\cdot}7 \times 10^5$ in winter.

In the F region, at sunset, the maximum electronic density is 9×10^5 in summer, and 6×10^5 in winter.

After sunset, in the E region, the maximum electronic density varies irregularly, since there are sometimes remarkable increases, even several hours after sunset. These happen when barometrical depressions occur at the place of observation or to the north of it.

In the F region, during the night, the maximum electronic density is sometimes observed to be decreasing regularly, which made it possible to calculate a value from 1×10^{-10} to 2×10^{-10} for the coefficient of ionic recombination; at other times, on the contrary, rapid increases of the maximum electronic density are noticed, which are followed by diminutions, and that also for many times successively during the night.

The increases of ionic density in the E and F regions appear by no means connected with one another.

Corresponding with perturbations in the earth's magnetic field, the virtual reflection height in the F region is increasing: no perceptible variation occurs in the E region.

During the solar eclipse of Oct. 11, 1931 ($13^h\ 6^m$ G.M.T.) not visible in Italy, I observed a perceptible diminution of electronic density in the E region and in the F one.

These facts can be explained by admitting the arrival, in the ionosphere, of electrons from the sun, which would invest even the shaded hemisphere (after A. Dauvillier's recent theory[1]).

Chapman's theory[2] (concerning the arrival of swiftly moving particles) does not appear to interpret easily the night increases of ionic density and the magnetic correlations regarding the F region alone.

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[1] *Comptes rendus*, **193**, 348, 1931.
[2] *Mon. Not. Roy. Ast. Soc.*, **92**, 413–420, 1932. *Proc. Roy. Soc.*, A, **132** 353–374, 1931.

Ball Lightning

ON the afternoon of Aug. 31 I was at Portofino watching across the bay a succession of heavy thunderstorms that drove up from the south over the Ligurian hills east of Rapallo. At about 3.30 P.M. a rain-curtain a couple of miles wide was moving northwards, completely obscuring a section of the coast-line. While this was opposite Chiavari two appearances of 'ball lightning' were seen by myself and two companions. (A third earlier one of brief duration was seen by one observer.)

Lightning flashes were frequent: at the time mentioned the rain curtain was pierced by two independent vertical flashes, one-half to one mile apart, which appeared not to reach the ground (or sea). Then, in the gaps between the lower ends of the flashes and the ground, two brilliant stationary lights appeared, lasting about five seconds in one case and at least eight seconds in the other, as though two powerful arc lights had been turned on. In both cases a second or so was required to attain maximum brilliancy, which was then maintained constant until the last second or so when the lights gradually dimmed and suddenly went out. This change in light intensity at the beginning and end may have been due to variation in thickness of the obscuring rain curtain. No specific sound was associated with the phenomenon, but this may have been due to the distance (probably ten miles) and to the almost continuous roll of thunder at the time. That the 'ball' discharges appeared stationary may also have been an effect of distance.

I have had no opportunity to inquire whether any record of these facts has appeared in the Italian Press or meteorological reports.

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Research Items

Co-operation in Dahomey.—Mr. Melville J. Herskovits publishes in *Africa*, vol. 5, No. 3, a study of Dahomean ethnology, based on field-notes collected during a trip to Dahomey, Nigeria and the Gold Coast in January-September, 1931. The civilisation of Dahomey is based upon an agricultural economy. Everyone must know how to cultivate the ground, whatever his rank. Women play an active part in economic life, cultivating, harvesting and marketing the crops. There is a class of 'free' women, due to this economic activity, who play the rôle usually assumed by men as the heads of families and become titular 'husbands' to their 'wives'. Dahomean men are organised into family vocational guilds, working in iron and brass, weaving cotton, etc., an exception being wood-carving which is an avocation exercised by all who have the necessary skill. The women's contribution to the crafts is the making of pottery, which is organised in districts according to the distribution of suitable clay, rather than in families, the guild organisation, however, persisting as in other vocations. The co-operative aspect of organisation pervades all Dahomean economic activity. The major expression of this is the *Dokpwe*—a term applied equally to the organisation and to the individual member. It is neither a guild nor a society, but is regarded as a 'force', the man power of Dahomey, as it embodies all 'young' men. The control is vested in an official known as the 'Chief of the Dokpwe' who is concerned not only with the control of the men under him in communal tasks, but also with funerals. The working of the organisation may be illustrated by the following example. If a man is ill at the time of the clearing of the fields, the Dokpwe will clear his land for him as no member and his family must be allowed to starve. It is, in fact, an association for mutual aid, so important that no man may be exempted from its call. If a man, even the king, in going along a path, sees a Dokpwe at work he must explain his errand and ask leave to proceed.

Central American Eccentric Flints.—The character and distribution of the so-called 'eccentric flints' of Central America are discussed by Capt. T. A. Joyce in his presidential address to the Royal Anthropological Institute, 1932 (*J. Roy. Anthrop. Inst.*, vol. 62, pt. 1). They are found, so far as known at present, only in the area occupied by the ancient Maya, an inverted triangle with its base lying between Palenque and Belize on the north and its apex at Copan in Honduras. Their meaning is obscure; their technique equals the finest products of prehistoric Denmark and is surpassed only by the finest 'ripple-blades' of Egypt. They are generally associated in groups, occasionally in graves, more often under sculptured stones bearing a date which can be related to our chronology. For example, the British Museum expedition to Pusilhá discovered a deposit of nearly one hundred examples of flint and obsidian under a stela which may be placed at about A.D. 202 (or three hundred years later according to the American scheme of chronology). The large series now in the British Museum shows that these flints can be classed according to type. They served no utilitarian purpose, and are purely ceremonial. The main types are 'blade' type and derivatives—winged, waisted, flanged, cruciform—the 'scorpion' type, the 'centipede' type and 'annulets' and 'crescents'. Some have been flaked to represent human heads; while recently a series of engraved obsidian flakes has been discovered at Tikál, which show the figures of the Maya gods in the style of the Dresden codex. Chert was used as well as flint and obsidian, the source of the last being, probably, Guatemala. The 'eccentrics' suggest several problems, for which at present there are no solutions. They seem to have been deposited in groups as 'foundation deposits' on sites of importance. Each group seems to include every variety in every stage of construction, and no single specimen shows signs of wear on its edges.

Redwing Breeding in Scotland.—More than once, in the northern counties of Scotland, it has been suspected that the redwing (*Turdus iliacus*) may have nested, for birds have been heard singing long after the spring emigration to the usual nesting haunts in Scandinavia and northern Europe had ceased. But only now has confirmation of this supposed extension of range been found (*British Birds*, Sept., 1932, p. 132). In the Moray Faunal Area (for obvious reasons no more definite locality is given) A. H. Daukes saw a pair in early June and later discovered the nest with six eggs in a solitary beech tree. Unfortunately about this stage the nest was robbed, probably by a rook, but the discovery of the greater part of the shell of one egg upon the ground helped, along with the nest, to confirm the identity of the birds. There is perhaps nothing very remarkable in the fact that a bird, common in Scotland and indeed considerably farther south in the winter, should have remained to nest, instead of departing for Norway or the Baltic provinces, but the first authenticated record of breeding in any part of the British Isles has its own special interest and may be part of a general extension of range southward which has been noted in other species.

Development *in vitro*.—C. H. Waddington (*Phil. Trans.*, *B* vol. 221, pp. 179–230, 1932) has cultivated *in vitro*, by the watchglass method, entire blastoderms of chick and duck removed from the egg during the first two days of incubation. Under the conditions of these experiments a chick embryo will remain alive for two to three days and during this time pursues its normal course of differentiation, except that the rates of differentiation and of growth are considerably slower than *in vivo*, the rate of growth being the more affected by the unusual conditions, so that embryos are obtained which are much too small for the stage of differentiation which they have reached. The results of experiments on the presumptive organ-forming regions are described, using blastoderms with a well-formed primitive streak but no head process, which were cut into portions transversely at various places along the primitive streak. The isolated endoderm has not been successfully cultivated. Isolated epiblast, cultivated from young or medium primitive streak stages, yields neural groove, notochord, somites, etc. Two epiblasts, cleaned of endoderm and placed so that their mesoderm faces were in contact, were cultivated and both developed neural grooves, but the lower soon died and degenerated. A normal neural groove may induce an extra neural groove in the other epiblast.

Fragments of the primitive streak, cleared of endoderm, were grafted between the endoderm and epiblast of other blastoderms of similar age, the epiblast not being cut in the operation. Anterior pieces of the primitive streak give rise to neural tissue, notochord and somatic mesoderm; middle pieces give rise to mesoderm, with or without neural tissue; posterior pieces probably never give rise to neural tissue.

Commercial Drying of Wheat.—In view of the probable future extension in the use of the combine-harvester machine in England where the climate renders the use of a drier advisable, the second report (No. 25) on the drying of wheat, issued by the National Research Council, Canada, should prove of particular interest to progressive farmers in this country. The report, which is a continuation and extension of that issued in 1929, deals with the effect of different conditions during the drying process on the subsequent milling and baking qualities of the wheat. The temperature of the hot air used and its rate of flow are factors of the first importance. Since the rate of drying increases with the heat content of the air per unit time, raising the temperature or increasing the speed of flow will dry the grain more rapidly. Beyond a certain point, however, fast drying is to be deprecated since it affects the baking quality adversely. In general, 180° F. is the highest temperature that can be used with safety and even this may cause injury if the rate of flow is too rapid. The temperature attained by the wheat during the drying is another factor that seems to be connected with baking quality. Over-drying or too rapid drying are the main causes of high grain temperatures, a condition which results in impaired baking properties. Milling quality, on the other hand, was unaffected by drying under the different conditions tested. Commercial drying must of necessity be carried out under widely different climatic conditions, and it is satisfactory that tests showed no detrimental effect on the baking quality of the wheat when drying was carried out in cold weather or with humid air.

Virus Diseases of Plants.—Dr. J. Caldwell has published the third of a series of investigations into the physiology of virus diseases in plants (*Ann. App. Biol.*, vol. 19, No. 2, pp. 144–152, May, 1932.) The aucuba mosaic disease of tomato behaves very differently on *Nicotiana glutinosa* and *Datura stramonium* from what it does on *Solanum lycopersicum*. It is very interesting that the virus multiplies very little in the leaves of *N. glutinosa* and does not spread far from the region of inoculation. *D. stramonium* is a 'carrier' and shows no symptoms, but the virus spreads to all parts of the host. An interesting demonstration that rupture or damage of a tissue must take place before virus can infect was given when it was shown that the intercellular spaces of a leaf of *N. glutinosa* could be injected with virus juice without any infection taking place. The damaging of any cells by rubbing the surface of the leaf immediately brought about infection.

Viscosities of Drilling Muds.—Messrs. H. A. Ambrose and A. G. Loomis contribute an article to the *Oil and Gas Journal* for July 7, in which they seek to show that, contrary to prevalent ideas, rotary drilling mud (such as a clay mixture) is not truly viscous. The resistance of mud to flow as expressed by whatever viscosity it may possess, determines the ease with which it may be pumped, and its ability to carry up cuttings and gas. These drilling muds do not have viscosities which are constant at constant temperatures, since this function tends to vary not only with its previous treatment, implying mode of preparation, but also with the shearing stress applied to it. The muds must be regarded essentially as suspensions of clay in water, and consequently the ordinary laws governing the motion of a truly viscous liquid are scarcely applicable. The authors deal with the subject from the point of view of flow in colloidal suspensions, and the mechanism of such flow. They touch on the mathematical analysis involved, and also on certain types of viscometers which have been used for determining this alleged viscosity.

Fatigue of Zinc-coated Steel.—When an iron or steel bar is subjected to repeated stress it breaks under a stress less than its statical breaking stress if the lower stress is repeated often enough. The 'fatigue cracks' which lead to the breakdown are found to originate in pittings on the surface due either to bad finishing or to subsequent corrosion. To prevent corrosion the iron or steel may be galvanised or have zinc deposited electrolytically on its surface and the effect of each of these processes on the durability of the specimen under repeated stress has been investigated by Messrs. W. H. Swanger and R. D. France at the Bureau of Standards and their results appear in the July issue of the *Journal* of the Bureau. Both the loaded beam and the stretched rod methods of test were used, and the specimens were either polished or pickled for galvanising or galvanised or stripped again or electroplated. The fatigue limits of the electroplated specimens were higher than those of the uncoated, those of the pickled, galvanised and stripped were lower than those of the untreated specimens. The authors ascribe this difference in the effects of the zinc coatings to the hardness of the layer of zinc put on by the galvanising process.

Conduction Phenomena in Oxide-Coated Filaments.—The quantum-theoretical study of semi-conductors and rectifying contacts has been developed independently by several workers during the past year. In a paper in the September *Proceedings of the Royal Society* R. H. Fowler and A. H. Wilson apply the theory to the case of conduction in the oxide layers used in dull-emitting cathodes. They calculate current-voltage characteristics which show the general features of the experimental curves—namely, a steep initial rise of current with voltage followed by a flatter portion and a further steepening. In order to explain the form of the i/v curves at the lower voltages they assume that part of the current is electronic (and described by the above analysis), the remainder being electrolytic and approximately ohmic. The authors consider that work along these lines may be developed to account for the lack of saturation observed in the thermionic currents from oxide-coated filaments.

Cosmic Ray Particles.—The *Physical Review* of Aug. 15 contains a further communication by C. D. Anderson on the cloud-chamber photography of cosmic ray particles. The method and results may be compared with those described in the preliminary publication of Blackett and Occhialini (NATURE, Sept. 3, page 363). The advantage of allowing the cosmic ray itself to set off the expansion is evident, since, in Anderson's work, of 3,000 random expansions only 62 gave measurable cosmic ray

tracks. Anderson, using an iron-core magnet, applied a magnetic field much larger than was possible with Blackett and Occhialini's air coils. The most significant difference between the results is the much larger proportion of particles with high energies (above 500×10^6 volts for electrons or 200×10^6 volts for protons) obtained by Blackett and Occhialini. Such particles were quite rare in Anderson's work. At first sight it appears that the Blackett-Occhialini apparatus may tend systematically to miss particles of low energy, or that their estimates of the high energies may be incorrect since they used small magnetic fields. It is important that this divergence should be explained, particularly as the particles of high energy are inconsistent with Millikan's views of the origin of cosmic rays by atom-building. Anderson observes associated pairs of tracks rather frequently, and one of these tracks is always an electron. He ascribes these pairs to disruption of a single atomic nucleus by the cosmic ray and he maintains that these can be explained without postulating neutrons in the cosmic ray stream. He also observes the scattering of the particles in a lead diaphragm. In the same number of the *Physical Review* W. F. G. Swann points out some consequences of assuming that the primary cosmic rays are electrons of very high energies. He suggests that such electrons may be incapable of ionising and may only occasionally give rise to secondary particles. He examines certain asymmetries in the distribution of the secondaries over the earth's surface, assuming that they are particles of energies of the order 10^9 volts.

Corrosion Resistivity of Metal.—Reference was made in NATURE of Aug. 13, p. 245, to a method devised by Mr. Zehnowitzer for determining the velocity of metallic corrosion, based on changes in the conductivity of the corroding liquid. In a letter to the Editor, Mr. F. C. Smith directs attention to a rather similar method worked out some years ago in the laboratory of the Gas Light and Coke Company, and described in a paper published in the *Transactions of the British Junior Gas Associations Joint Proceedings* (Vol. 18, 1927–1928). The special problem under investigation by Mr. Smith was the rate of attack of different varieties of iron by water saturated by carbon dioxide, in the absence of oxygen. The measurements themselves have special importance for gas technologists, but the procedure, which appears to be little known outside the gas industry, may interest a wider circle. The corrosion was carried out in a conductivity cell furnished with the usual platinised platinum electrodes and joined to a Kohlrausch bridge; as the carbonic acid attacked the iron specimen, liberating hydrogen, the formation of ferrous bicarbonate produced a marked drop in the resistance, which, in one experiment, fell, in the course of 6 hours, to about one-third of the initial value. The resistance-change, which blank experiments showed to be solely due to the action of carbonic acid on the metal, proved a convenient measure of the rate of attack. The precautions necessary for good results included a careful control of temperature, the use of water redistilled from permanganate and the strict exclusion of oxygen. The numbers obtained for a series of irons indicate that the anaerobic attack upon iron by aqueous carbonic acid increases with the sulphur content of the metal, although other elements appear to influence the result.

Astronomical Topics

Comets.—Periodic comet Brooks (2) was detected on its return by Prof. G. van Biesbroeck at Yerkes on Sept. $25^d 8^h 14 \cdot 6^m$ U.T., R.A. (1932·0) $0^h 46^m 13 \cdot 8^s$, N.Decl.2°55′10″, mag.12·0. The comet was discovered in 1889 and found to have been very near Jupiter in 1886, when its orbit must have been greatly altered. It was seen again in 1896 and 1903, after which there were no certain observations until 1925; it is doubtful whether a single observation made in 1910 belongs to it. It had again approached Jupiter closely about 1921, but the calculations of Prof. Dubiago led to its recovery. Both he and Mr. F. R. Cripps calculated the present return; their results were almost identical, but the date of perihelion resulting from the above position is Oct. 9·49 U.T., which is about two days later than the prediction. It may be found by going 0·31 of the way from the second ephemeris in the B.A.A. Handbook to the first one. The present apparition is the most favourable possible, opposition coinciding with perihelion. The comet is 1932 *m*; it is the first time that there has been a comet *m*.

Copenhagen Circular 403 contains the following elliptical orbit of the comet Peltier-Whipple from Copenhagen observations of Aug. 10 and 24 and Sept. 9.

T	1932 Sept. 1·86128 U.T.	
ω	38°28′ 31·5″	1932·0
Ω	344 30 35·4	1932·0
i	71 42 32·6	1932·0
q	1·037175	
e	0·976172	
Period	287 years	

Harvard Card 240 announces that Dr. A. D. Maxwell has found elements which are almost the same as the above, though the observations used were all different; the arc in each case is a month in length. There is no comet in the catalogues that seems likely to be the same. An ephemeris was given in NATURE of Oct. 1, p. 513, which is near enough for finding it. It is now about magnitude 12.

Solar Corpuscular Rays.—A letter from Mr. H. P. Berlage, Jr., of the Royal Magnetical and Meteorological Observatory, Batavia, proposes the question: Are the solar corpuscular rays producing auroræ and magnetic storms identical with the solar component of ultraradiation? He states: "Now that converging evidence points to a corpuscular nature of the ultraradiation, what arguments exist against simply identifying the solar corpuscular rays, which cause auroræ and magnetic storms with the solar component of ultraradiation? The suggestion is that different stars emit differently penetrating ultrarays, and the question, why no appreciable solar component could be detected reduces to stating the fact, that the solar ultraradiation is stopped in a height of 100 km. above the surface of the earth". But this seems to amount merely to giving a name, usually reserved for rays with the great penetrating power needed to reach the ground, to rays of such inferior penetration as to be stopped at 100 km. height. This is very far from being an 'identification', and the suggestion seems to add nothing material to our knowledge.

Training of Electrical Engineers

AT the International Congress of Electricians held in Paris last July, interesting papers were read by various authors describing the training given in their countries to young men desirous of qualifying for the higher posts in the electrical engineering profession. It appears that, as a rule, the degree of B.Sc. in engineering, or its equivalent, is given after going through a three or four years' course in a technical school or college. It is impossible in the workshops of a college to give a student that insight into methods of management and actual operating that can only be obtained in works offering machinery or apparatus for sale. Hence engineering graduates or those possessing recognised diplomas have to undergo a special apprenticeship course in works, railways, power or distributing stations or with communication companies in addition to their academic training.

These apprenticeship courses are usually at least a year in length. It is highly advisable that there should be a close connexion between works and college staff, to whom most of the outgoing students have to look for advice as to the course they should follow. There is naturally a close connexion between many works and engineering colleges. The supervisors of the apprentices make their own choice and are not necessarily impressed by the academic qualifications of the young men they interview. They have to choose men whom they think will qualify rapidly for staff posts. Large companies who take a number of higher apprentices every year take only a limited number from any one country or from any one engineering college. Trade considerations in Great Britain and other countries make it advisable to take overseas students and foreigners. Several of these firms pay their graduate apprentices, generally called 'student apprentices', a weekly wage varying from 10*s*. to 50*s*., but some ask for a premium which is generally more than paid back by a weekly wage. This appreciably lightens the present somewhat onerous burden of the cost of living.

Most of the papers read at the Paris meeting dealt with the syllabuses of training colleges for the early part of the engineering training of students. It seems generally recognised that in the present economic conditions throughout the world and the very varied requirements of engineers in the different branches of the industry, it is necessary that the syllabus should not be overburdened with subjects. In Norway it includes architecture, political economy and finance. In Sweden national and political economy, technical hygiene and the building of edifices are taught. In Poland special stress is laid on methods of electrifying the country with a view to its future prosperity. In Italy, radio technology is in the front rank. It has been introduced into the programme of every industrial school. In the University of Bologna there is a two years post-graduate course for radio engineers. The degree of Ph.D. is awarded for physics and for mathematical physics. Special importance is attached to photo-electricity, television and the technique of radio-telegraphy and telephony. In Spain and many other countries stress is laid on long distance communication by telephony through wires and through space. Technical teachers everywhere are fully aware of the importance of the rapid and spectacular advances in methods of communication between distant stations which have been made during the last few years.

An interesting paper on electrical education in the United States was communicated by Prof. A. E. Kennelly. He divides training institutions into two groups, the collegiate group and the industrial group. The first contains universities and technical institutes of university rank; the second includes the research and training schools of industrial organisations, technical institutes, and professional, commercial, and correspondence schools. Actually there are 150 schools of collegiate type in the United States. These give full instruction in electrotechnics. In addition, there are 750 other schools which give partial courses in the subjects connected with electrical engineering. The complete electrotechnical course usually lasts four years. During the last two years of the course, students can specialise in transmission and distribution of energy, electric traction or electrical communication, but no two engineering colleges in the United States have identical programmes. In 1893, a society was founded for the advancement of technical knowledge. It has now 2,250 members, practically all of whom are professors or teachers in technical schools. Their judgments and decisions influence greatly the nature of the syllabus adopted by a college.

A certain number of American colleges give 'sandwich' courses of training, half the time of the students being spent in college and the other half in works. The student spends a certain number of weeks in works and a certain number in college alternately, the length of the cycle varying between two weeks and a year. For students who wish to take up 'heavy' engineering, this system has advantages. The practical work shows how important theory is and hence students pay closer attention to theoretical work. Some of the large colleges have a regular college course for four years for some of their students and simultaneously a sandwich course for others. One of the advantages is that the college can take more pupils and thus the overhead charges are reduced. There is a great variety of colleges of all kinds in America. Prof. Kennelly thinks that it would be a calamity not only for the United States but also for the world if any of these colleges cease to exist. The disappearance of a good school, whatever its type, may mean that those students who had intended to enter it must either go to some other college which is not so attractive to them or else seek to acquire their scientific knowledge by experience and private study, a method sometimes successful but more often leading to a great waste of energy.

Prof. C. L. Fortescue read a useful paper on the education of electrical engineers in Great Britain. Those students who intend to qualify fully as engineers in Great Britain usually leave their secondary or public school at the age of eighteen years, spend three or four years at a university or technical college and finish up with two years as a 'student apprentice' in works, power stations or railways. It will be seen that the training is an expensive one as during the five or six years the student is not self-supporting.

In Great Britain, the Institution of Electrical Engineers looks after the interests and maintains the standard of the profession as a whole. It divides

young electricians into two groups, students and graduates. The students of approved colleges and apprentices and assistants in engineering works can become 'students'. When a student has passed certain qualifying examinations and has attained the age of twenty-one years, he can be elected a graduate. A graduate, however, is not a 'chartered electrical engineer'. This status can only be attained after his training and experience exceeds seven years, two of which must have been in a position of superior responsibility in the profession. He has to send in an election form signed by five members and giving a complete account of his training and experience, which is scrutinised by an election committee. He must also be twenty-six years of age. When he fulfils all these somewhat onerous conditions, he is elected an associate of the Institution, and can call himself a chartered electrical engineer.

It will be noticed that there is a discontinuity in the training of an electrical engineer, namely, the gap between the university or technical college and works. Most students have no connexion with engineering and so have to make their own arrangements with manufacturing firms. Naturally, they want to go to the best-known firms, but it generally happens that these firms have already all the student apprentices they want. Hence they have to try to get into works about which they know nothing.

This has led to the adoption by a few colleges of the 'sandwich' system of training. The best-known of these colleges is Faraday House, London, which was founded more than forty years ago and now has about four hundred students. The course lasts for four years. The first year is a purely collegiate course in general engineering. During the second year the student is apprenticed under supervision to a mechanical engineering works either in Great Britain or abroad, the college making all the arrangements for him. The college is affiliated with 170 works and railways in Great Britain and abroad, for teaching purposes. Advanced theoretical training is given in college during the third year, and for the final year the students go to electrical manufacturing works and power stations throughout the country and to railways, and communication companies, etc. Those who have passed successfully through the course, several of whom also take the London B.Sc. (Engineering), receive the diploma which enables them to become graduates of the Institution of Electrical Engineers without further examination. The advantage of the system is that the student is under the same supervision throughout his course.

The recent extension of research laboratories in connexion with works has led to a limited demand for men who have done post graduate research work in university laboratories. These men usually write theses which h[illegible] them to get the higher degrees of M.Sc., Ph.D. and D.Sc. Research laboratories also take young graduates whom they train specially in their own methods of research so as to qualify them for posts on their staff.

A.R.

Solid Solutions and Liquid Mixtures

THE discussion arranged in Section B (Chemistry) on Sept. 6 at the York meeting of the British Association, was finally divided into two parts as it was agreed that the differences between solid solutions and liquid mixtures were too great for the subjects to be covered usefully in a single discussion. Prof. C. H. Desch in his paper on re-arrangements in the solid state referred to the importance of solid solutions in metallurgy and said that systems in which a series of solid solutions, stable at high temperatures, resolves itself into two or more phases on cooling are of frequent occurrence. Such systems are of two types. In the first, and most usual, the change takes the form of the separation of a new phase from solution in the same manner as the crystallisation of a salt from water. A solubility curve can be drawn and eutectoid structures similar to the eutectics produced from liquid solutions are produced. Familiar examples are the iron-carbon and iron-nickel systems, and analysis of the constituents shows that a definite migration of nickel has taken place in the solid phase. In the second type of re-arrangement which has been observed in recent years, a solid solution homogeneous at high temperatures and having the solute atoms statistically distributed throughout its lattice assumes a new arrangement on cooling through a certain point, the solute atoms taking up regular positions and so forming a super-lattice. The change is reversed on heating. A typical example is furnished by the gold-copper alloys. The equilibrium is attained very quickly and the change can be followed by electrical resistance tests. Magnesium-cadmium alloys give a similar series and the changes are at present largely unexplained although the number of such systems may be considerable.

The discussion on mixed liquids was opened by Prof. Irvine Masson who indicated that its scope is limited to mixtures of non-electrolytic fluids. The main chemical interest in such liquids lies in the formation of inter-molecular compounds but Prof. Masson pointed out that before deviations of liquid mixtures from an ideal mixture law can be interpreted as evidence of chemical interaction or compound formation, the effects of the other possible causes of combination between either similar or dissimilar molecules must be disentangled, namely, the van der Waals' cohesion forces and electrical coupling between polar molecules. In each of these alternatives as in chemical combination we have also to contemplate the reverse process of dissociation. In actual fact van der Waals' cohesion is present in every mixture of any two liquids. Electrical coupling between polar molecules occurs in all mixtures except the 'normal' liquids. Thus where chemical combination occurs it is invariably accompanied and complicated by the other two forces.

Discussing the criteria for a normal liquid Prof. Masson pointed out the danger of assuming that those liquids are normal which when mixed together give straight line property-composition curves. The use of the Ramsay-Eötvös rule concerning surface energies, Trouton's rule concerning latent heats, and Debye's polar moments, leads to the characterisation of a normal liquid as one the molecules of which remain sufficiently independent to attract one another by no forces other than the van der Waals' cohesion which they show in the vapour state. A normal liquid thus has the characteristics of a non-polar but imperfect gas. For properties such as specific volume, viscosity, vapour pressure and heats of mixing, all of which are strongly influenced by cohesion and give

indirect measurement, fundamentally, of inter-molecular cohesion, the simple mixture law does not hold. We are dealing with two opposing actions, the influence of the cohesion of each kind of molecule with others of its own kind being attenuated by the dilution, while on the other hand the attenuation is counteracted, more or less, by the mutual cohesion set up between the two kinds of component molecules. We cannot state precisely what the normal behaviour of mixtures of two non-polar substances would be but the deviations from the straight line due to cohesion reach their maximum, for a given pair of components, at a composition not far from equi-molecular.

With regard to electrical coupling between polar molecules, after referring to the view which attributed the van der Waals' forces to transient polarisation of non-polar forces Prof. Masson pointed out that as before the magnitude of the deviation depends on two opposed influences. In addition while the end-to-end coupling of polar molecules gives a complex of larger electric moment, in the side-by-side coupling the two individual polarities tend to neutralise each other, and accordingly caution is required in interpreting data for electric moments. Quantitative interpretation of the cohesions displayed by polar molecules is very difficult and Prof. Masson considers that Langmuir's presentation of the mutual cohesions of compound molecules as additive functions of their chemical constituents is inadequate. Evidence based purely on deviations from the mixture-law which might be accounted for by the relatively strong deviations due to mutual dipole cohesion is accordingly insufficient to establish the formation of chemical compounds, short of the isolation of a solid compound with distinctive properties.

Prof. G. Kendall in his paper on compound formation in liquid mixtures classified compounds existing in liquid mixtures in two types, addition compounds and substitution compounds. In the former, of which acetic acid-aniline forms an example, there is a definite increase in molecular complexity and a wide deviation in physical properties from the mean of the components. In the second type, of which phenol-cresol is an example, there is no increase in molecular complexity and the physical property-composition curves are more nearly linear. Formation of compounds of the first type depends mainly on the diversity in electrochemical character of the radicals of the components, the extent of compound formation increasing with such diversity. The reverse holds with compounds of the second type, similarity in the radicals being the dominant factor, part of the associated molecule being replaced by essentially equivalent groups. The results of a detailed examination of the two ternary systems ethyl acetate-water-alcohol and ether-water-alcohol were discussed in relation to these generalisations.

Discussing dipole association in liquid mixtures Dr. N. V. Sidgwick pointed out that in contrast to non-associated substances, associated substances give a molecular polarisation curve which rises to a maximum and then falls with increasing concentration; with non-associated substances the molecular association decreases from infinite dilution as the concentration increases. The dipole association may be due to an orientation of the molecules by the dipole forces, or to their polymerisation, and molecular weight determinations and determinations of the molecular polarisation enable the degree of association, x, to be calculated on the assumption that non-polar double molecules are formed. Thus the values of x obtained for nitrobenzene, which has a molecular polarisation five times as great at infinite dilution as in the pure liquid, by electrical and cryoscopic methods in benzene agree roughly up to about $2N$. solutions (0·46 by polarisation, 0·57 by cryoscopy). The mass-action association constant rises considerably from 0·26 at $0{\cdot}1N$. to 0·39 and 0·77 at $2N$. showing that the association is not due to a definite polymerisation but to an orientation of the polar molecules which diminishes their activity. The values of x obtained for nitrobenzene in different solvents, decrease with the dielectric constant of the solvent as is shown in the table below:

Solvent.	Dielectric constant.	x at $1N$.
Carbon disulphide	2·63	0·353
Benzene	2·29	0·313
Carbon tetrachloride	2·24	0·284
Cyclohexane	1·88	0·269

Oceanographic Instruments*

THE most complete survey of the physical oceanography of an ocean was carried out by the German research vessel *Meteor* in the South Atlantic. The plan of the expedition centred largely upon discovering the general movement of the water masses, the circulation theory of Bjerknes having provided an additional means of attacking this problem. This necessitates exact data of the distribution of density of the water throughout the ocean, as do all hydrographic calculations. These values of density are obtained by calculation from the temperature and chloride content of the water at various depths and the greatest attainable accuracy is sought, since the final picture rests on very small differences. The years 1925–27 were spent by the *Meteor* in collecting such data at more than three hundred positions down to depths often exceeding three miles. Gear and instruments must stand up to their work under severe conditions, so it says much for their efficiency that the original plans were fully carried out.

The results of the expedition are now being published. Part I of vol. 4, "Ozeanographische Methoden und Instrumente" by Wüst, Böhnecke and Meyer, gives a very full account extending over 300 pages with numerous illustrations of the instruments—thermometers, water bottles, winch and current meters. A final chapter is devoted to the technique and organisation of chloride titrations carried out on board.

Two types of deep-sea reversing thermometers were used, one with an outer casing protecting it from the effect of pressure, the other not so protected. The latter acts as both thermometer and manometer. It was found in calibrating to have a constant pressure coefficient and was used to calculate the actual depths at which water samples and tempera-

* Deutsche Atlantische Expedition auf dem Forschungs—und Vermessungsschiff *Meteor*, 1925–1927. Wissenschaftliche Ergebnisse, herausgegeben im Auftrage der Notgemeinschaft der Deutschen Wissenschaft von Prof. Dr. Albert Defant. Band 4, Teil 1: Ozeanographische Methoden und Instrumente. Von Dr. Georg Wüst, Dr. Günther Böhnecke und Dr. Hans H. F. Meyer. Pp. xii+296+9 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1932).

tures were taken. The following table shows the maximum and mean error of the depth as obtained by this means.

Actual Depth.	Maximum Error.	Mean Error.
100 metres	± 6 metres	± 3 metres
500 ,,	± 9 ,,	± 4 ,,
1000 ,,	±14 ,,	± 6 ,,
2000 ,,	±23 ,,	± 9 ,,
3000 ,,	±32 ,,	±12 ,,
5000 ,,	±49 ,,	±19 ,,

In taking soundings or samples from great depths, a material time is occupied by the lead and apparatus sinking to the desired depth. Meanwhile the ship may have drifted some distance, however skilfully manœuvred, and the line strayed from the ship making an angle to the vertical. During the expedition the angle of stray was observed and the effect of stray upon the actual depth reached investigated from the numerous data available.

A chapter is devoted to the protected type of reversing thermometer, in which an improvement was effected by using a thermometer tube of semi-circular section, the graduations being marked on the flat. The zero point of the thermometers in use was found at frequent intervals and diagrams are given showing the change in zero point with time.

There is no doubt that this volume will be of great assistance to anyone equipping an expedition for similar work.

Preservation of Timbers

IN *Forest Bulletin* No. 75 (Economy Series, 1931) of the Research Institute, Dehra Dun, India, Mr. F. J. Popham discusses the "Preservation of Indian Timbers—the Open Tank Process". This process consists essentially in submerging timber for a sufficient length of time in hot preservative and in keeping it submerged whilst the preservative is allowed to cool. A modification of this treatment, known as the butt treatment, is considered in Chap. ii of the *Bulletin*. In describing the method, the following considerations are dealt with by the author: (1) the vessel used for the treatment; (2) method of heating the preservative; (3) method of submerging the timber; (4) the preservative to be used; (5) the temperature of the preservative; (6) length of time to obtain desired results; (7) should the wood be seasoned before treatment; (8) varying treatment for different timbers; (9) cost of treatment.

It is recognised that although the open tank process of treating timber has many limitations, it also has much value, especially in India; and, it may be added, in many other parts of the British Empire, where there are many small users of timber who cannot afford a pressure plant. The capital outlay required for a full-sized pressure plant restricts the application of the pressure process considerably and leaves a wide field untouched. The open tank process, on the other hand, is cheap, and can have a wide application in regions and under conditions where the more expensive process is out of the question. The *Bulletin* is accompanied by five plates of line drawings illustrating the text descriptions. In an appendix a list of species of timbers not treatable in the heart wood by the open tank process is given.

Under the auspices of the Council for Scientific and Industrial Research, Commonwealth of Australia, Mr. J. E. Cummins has drawn up a small treatise entitled "The Preservative Treatment of Fence Posts (with Particular Reference to Western Australia)" (*Pamphlet* No. 24, Melbourne, 1932).

M. J. H. Boas, Chief of the Division of Forest Products, in a foreword, points to the inevitable experience of all countries which commence with what appears to be inexhaustible forest resources. Australia was fortunate in possessing timbers of remarkable durability under general conditions of service. These timbers were at one time plentiful; but as experience proved their value, the demand for them naturally increased. Supplies have in consequence become scarcer and prices are rising. Under these conditions the preservative treatment of less durable species becomes, not only economically possible, but also desirable. This is the seemingly inevitable cycle in all timber-producing countries. By the time experience has shown the true value of certain species for particular purposes, the demands of settlement and exploitation of the forests cause a serious depletion in the supply. Fortunately it is possible to treat many less durable species in such a way as to render them highly resistent to the attacks of fungi and white ants. On a farm there are generally supplies of fence post timbers which, when treated with preservatives, will have a length of life several times that of the untreated wood. The pamphlet sets out methods of treatment which have been shown to pay and can be practised by the farmer; the plant is cheap, can be easily and quickly erected, and the methods of treatment are simple. They are based on the treatment of 1,800 fence posts in West Australia.

Mr. Cummins points out that from the earliest days of farming in Western Australia the raspberry jam or jam post (*Acacia acuminata*) was recognised as the ideal timber for fencing posts and that fences constructed fifty to sixty years ago are still in a perfect condition. Jam, however, generally grows on good wheat land. In addition to an increase in farming areas in the jam country adjoining the Great Southern and Midland Railways, the so-called eastern wheat belt has been developed. This country carries little, if any, jam but several non-durable timbers. Jam posts were obtained, therefore, for the fences whenever possible, with the consequence that supplies are becoming scarcer and will become more so in future. With the increased price and reduced supply, the eastern wheat-belt farmer had to add a heavy freight to the initial cost of his fences.

As in the past in Australia, and elsewhere in the Empire, in clearing the land for the extension of agriculture, tea, coffee, rubber and so forth, the practice was, and is, in Australia, to destroy the greater part of the standing non-durable timber. The author's aim is to show that at very little extra cost fence posts could be cut from this material. Mr. Cummins deals with this question, as also that of material from thinnings from woods under proper management. He then discusses the main causes of timber deterioration and the reasons for differences in durability in different timbers. Preservatives, plant and estimated costs are considered, which merit the close attention of all interested in this question.

University and Educational Intelligence

CAMBRIDGE.—Prof. Walter Langdon Brown, regius professor of physic, and Prof. J. E. Lennard-Jones, Plummer professor of inorganic chemistry, have been elected fellows of Corpus Christi College.

WALES.—The Council of University College, Cardiff, at its meeting on Sept. 30 appointed Dr. W. F. Cassie as assistant lecturer and demonstrator in civil engineering in place of Mr. J. F. Barlow, who has resigned. The extension to the Metallurgy Department is now practically finished, and will be ready for occupation in the near future. Additional accommodation has been found necessary for the Zoology Department. This has been secured by extending the senior laboratory, and by building a new 'honours' laboratory.

SIR C. V. RAMAN, F.R.S., Palit professor of physics in the University of Calcutta, has been appointed director of the Indian Institute of Science, Bangalore, to succeed Dr. M. O. Forster, F.R.S., on his retirement in April next year.

SEVEN demonstrations of specimens in the Museum of the Royal College of Surgeons, Lincoln's Inn Fields, W.C.2, will be given by Sir Arthur Keith, Mr. Cecil P. G. Wakeley and Mr. R. Davies-Colley on Mondays and Fridays, beginning Oct. 17, at 5 P.M. The demonstrations are open to advanced students and medical practitioners.

As the result of a suggestion by the Association of Special Libraries and Information Bureaux, the School of Librarianship at University College, London, has instituted a course of training for special librarians. The course is open to graduates in faculties other than that of arts who desire to train for posts in special libraries, research departments, information bureaux, etc. It includes lectures on English composition, other languages, bibliography, cataloguing and indexing, literary history and book-selection, classification, history of science, palæography and archives, library economy and special library services. To meet the needs of the course, the regulations for the diploma in librarianship in the University have been modified. This course offers a splendid training for those who wish to enter the libraries of research departments, Government works, university and State libraries and other fields of activity, where scientific and technical knowledge, linguistic attainments and special training in the organisation of research are needed.

THE autumn programme of the twentieth annual series of Chadwick Public Lectures begins on Oct. 20 at 5.15 p.m., when Sir Humphry Rolleston will repeat in the theatre of the Royal United Service Institution, Whitehall, the Chadwick Lecture he delivered at the Paris Academy of Medicine last April, on "The Pioneers and Progress of Preventive Medicine". Sir William Collins, chairman of the Chadwick Trustees, will preside and at 5 o'clock will present to Mr. Alasdair Robertson the Chadwick Gold Medal and Prize for excellence in municipal engineering and hygiene, which is annually awarded to a student at University College, London, who has distinguished himself in the technique and sciences of engineering and sanitation. Other Chadwick Autumn Lectures are "Hygiene in the Far East—Progress under Difficulties" by Prof. Kielstra, of Leyden, who has had experience of these difficulties in the Dutch East Indies (Nov. 1); Sir Pendrill Varrier-Jones on "The Employment of Tuberculous Patients" (Nov. 15); and Dr. T. Carnwath, senior medical officer of the Ministry of Health, on "Public Health Administration" (Dec. 1). Discourses will also be delivered by Prof. S. D. Adshead at the Technical College, Bradford, on Nov. 21, on "Some Recent Developments in the Housing Problem" and by Dame Louise McIlroy at the Town Hall, Gateshead, on Nov. 25, on "Maternal and Infant Welfare". All Chadwick lectures are free and no tickets are required for admission. Further information about them may be obtained of the secretary, Mrs. Aubrey Richardson, at the offices of the Trust, 204 Abbey House, Westminster, S.W.1.

Calendar of Geographical Exploration

Oct. 11, 1579.—Sarmiento in the Strait of Magellan

Pedro Sarmiento de Gamboa sailed from Callao. Sarmiento had been many years in Peru, where he had become deeply versed in the ancient traditions of the Incas and had learnt of a voyage which they had made "towards the setting sun". Sarmiento then himself made this voyage from Peru and later, in 1567, discovered the Solomon Islands. His 1579 voyage was undertaken with the aim of intercepting Drake in the Strait of Magellan, it being thought that he would return that way. Sarmiento explored the channels in the Chonos Archipelago and carefully surveyed the Strait of Magellan. On his return to Spain he urged that the Strait should be fortified and colonies set up. In 1581 he sailed to carry out these suggestions, and after meeting many disasters, landed some of the colonists at a spot named San Felipe. He left for Chile, meaning to return with supplies; stormy weather intervened and he set out towards Spain but was taken prisoner by Raleigh. All but one of Sarmiento's colonists perished from famine, Cavendish inhumanly refusing to help those who were still alive when he arrived there in 1587.

Oct. 11, 1492.—Christopher Columbus

After a voyage in which he left Spain on Aug. 3, 1492, and the Canaries on Sept. 9, Columbus sighted land, probably Watling Island in the Bahama group, on this date. He reached Cuba on Oct. 28 and sailed to Haiti, from which island he returned to Spain in March, 1493. Academic controversies have recently raged round his name from the point of view of his aims and of his failure to grasp the significance of his discovery. But no criticism can affect the fact that he made the pioneer voyage across the Atlantic to the islands off the coast of Central America, and thence returned, thus opening up new possibilities in navigation and pointing the way for the rapid series of discoveries which followed his voyage. These subsequent discoveries so widened the outlook on world geography that it is difficult for modern writers to realise the limits of the geographical conceptions of the pre-Columban age. In a second voyage, in 1493, Columbus discovered Dominica and a number of adjacent islands and again examined Cuba, which he quite naturally, considering the fixed ideas of his time, thought to be part of the mainland of Asia. In 1498 he discovered Trinidad, noted the fresh water of the Orinoco River far out at sea and sighted the mainland of South America, near Paria. In a fourth voyage, Columbus in July

1503 sighted the coast of Honduras and followed it southward to the Gulf of Darien.

Oct. 13, 1884.—Sir Thomas Holdich's Surveys

The Russo-Afghan Boundary Commission assembled at Sarrakhs, the point where Russia, Persia and Afghanistan meet. Sir Thomas Holdich, with a very small staff, succeeded in carrying out a detailed and accurate survey from Kandahar to the Helmand, and thence through western Afghanistan to the Hindu Kush near Herat. He had already carried out some work on the north-west frontier of India in 1881–83. In 1889 he surveyed the Zhob valley and explored Makran. The Perso-Baluch Boundary Commission, and the Pamir Boundary Commission worked under his direction and his work and that of his surveyors covered large areas of previously unexplored country in Afghanistan, Baluchistan and the north-western regions of India. In 1902 Holdich directed the work of the boundary commission on the Chile-Argentine frontier in which Francis Moreno took part. Moreno had between 1873 and 1902 carried out a series of explorations in the Andes, Patagonia and Argentina which were of the first importance.

Oct. 14, 1872.—N. M. Przhevalsky's Explorations in Asia

The famous Russian explorer Przhevalsky reached Kuku Nor from Kiakhta, following much the same route as that of the Abbé Huc in 1843–46. In this 1870–73 journey Przhevalsky, with only three companions, crossed the Gobi desert, reached Peking, explored the Ordos, the Ala-Shan and the upper course of the Yangtze Kiang, and got so far as the Di-Chu River in Tibet. In 1877 he re-discovered Lop Nor, in 1879–80 he penetrated the Tsai-Dam and followed the valley of the Tibetan river, Kara Su, approaching within 170 miles of Lhasa. Altogether he made five expeditions into these regions, in addition to an earlier exploration, carried out single-handed, in the Ussuri region, in 1867–69. He died at Karakol on Lake Issyk Kul when he was attempting a further journey to Lhasa. His interests were wide and in addition to their geographical importance, his journeys resulted in valuable collections of plants and animals and of ethnographic data. He discovered the wild camel and the early type of horse now known by his name.

Oct. 15, 1819.—South Shetland Islands

William Smith in the *Williams* sighted the South Shetland Islands and claimed them for Britain. Smith was a trader and had on a previous voyage seen the islands, but had not ventured near them because he feared to lose his cargo. The *Williams* was in the following year chartered by the British naval commander of the Pacific station for a voyage of discovery. Edward Bransfield was put in charge and explored and charted the group between Jan. 16 and March 21, 1820.

Societies and Academies

PARIS

Academy of Sciences, Aug. 17 (vol. 195, pp. 429–448).—**Charles Achard and Ho-dac-an**: Some observations on the flocculation of suspensions of myxoprotein by electrolytes. The existence of two zones in the flocculation curve of myxoprotein by the two electrolytes studied, $AlCl_3$ and $ThCl_4$, leads provisionally to two hypotheses: myxoprotein contains two different substances or there is a change of sign in the protein.—**E. Bataillon and P. Tcherniakofsky**: The sterility of the male hybrids resulting from crossing *Molge marmorata* and *Molge cristata*.—**R. Risser**: The proper dispersion with *n* errors in the case where each of the component errors is ruled by a simple law. An attempt at an analytical representation.—**Jacques Devisme**: Certain families of polynomials.—**D. Iwanenko**: The constitution of the atomic nuclei.—**A. Portevin and P. Bastien**: Contribution to the study of the ternary system magnesium-aluminium-copper.—**Li Shi Lin**: Study of some ottrelite schists from China.—**Henry Germain**: Some fresh-water diatoms living in mucous tubes.

Aug. 22 (vol. 195, pp. 449–472).—**E. Bataillon and Tchou Su**: Crossings (second generation) between a female hybrid and males of two parental types.—**Paul Mentré and O. Rozet**: Certain tetrahedral surfaces.—**Georges Giraud**: An extension of the theory of the Fredholm integral equations, with application.—**Gr. C. Moisil**: The integration of matrices.—**A. Aleyrac**: Remarks on the support of a body by (wing) beats.—**J. Solomon**: The theory of Einstein and Mayer and the equations of Dirac.—**G. Bruhat and P. Chatelain**: The photoelectric measurement of the rotatory dispersion of some sugars in the beginning of the ultra-violet. Measurements are given for wavelengths ranging from 5,461 to 3,021: the formula of Lowry and Richards was found to hold over this range.—**Michel Polonovski and Albert Lespagnol**: The constitution of allolactose. This sugar is shown to be an isomer of lactose.—**D. Ivanoff and T. Roustcheff**: The alcoholysis of esters by mixed organomagnesium alcoholates and phenolates. A study of the reaction $R.CO_2R_1 + R'OMgX = R.CO_2R' + R_1OMgX$. In the eleven cases examined the yields varied from 0 to 69 per cent.—**F. Blanchet and L. Bethoux**: The influence of the geological nature of the soil and of the mineralisation of drinking water on the frequency of cancer in man.

Aug. 29 (vol. 195, pp. 473–504).—**C. Camichel, F. Beau and L. Escande**: The similitude of short hydraulic systems: experiments on the dock of the port of Havre.—**G. Tzitzéica**: Conformal representation.—**Torsten Carleman**: The characteristics of the torus.—**Georges Bouligand**: Various ideas concerning infinitesimals.—**Alexandre Ghika**: The development in series of uniform monogene functions.—**Giulio Krall**: The limiting state resulting from the tides for the movement of a planetary system.—**P. Vaillant**: A device susceptible of increasing the precision of optical spectrophotometric measurements.—**J. Prat**: The combinations of arsinic acids and hydrochloric acid.—**Vale Vouk**: The biology of *Codium Bursa*.—**A. N. J. Heyn**: The method of determining the plasticity of cellular membranes.—**G. Viaud**: The phototropism of *Daphnia pulex*: the rôle of memory in phototropism.—**G. Champetier**: A method for determining the composition of addition compounds of cellulose.—**Jean Roche**: The muscle hæmoglobins. Muscle and blood hæmoglobins are representatives of the same type of pigment the spectra of which are determined by the same laws.

CRACOW

Polish Academy of Arts and Letters, July 4.—**Stan. Ziemecki**: The Raman spectra of naphthalene derivatives. The spectra of five naphthalene derivatives have been examined. The line 1376 is always

present: it is very intense and evidently characterises the naphthalene nucleus. These results are analogous with those obtained with benzene. Certain well defined types of molecular structure can be established by the Raman spectrum.—**L. Marchlewski** and **Wl. Gabryelski**: The absorption of the ultra-violet rays by certain organic substances (27). A description of the absorption spectra of the polysaccharides.—**L. Marchlewski** and **T. Surzycki**: The absorption of the ultra-violet rays by certain organic substances. (28)—**K. Dziewonski, J. Moszew, Mlle. G. Dortheimer**, and **W. Rozycki**: A new method of synthesis of compounds derived from quinoline.—**T. Domanski** and **J. Suszko**: α-Quinidine. By treating quinidine with strong hydrochloric acid and submitting the product to alcoholic alkali solution, a new alkaloid, α-isoquinidine, is obtained.—**St. Kreutz**: The luminescence of minerals in relation with the places at which they are found and with the conditions of their formation. The differences between the luminescence of minerals of different places of origin is marked, and may be of service in determining the country of origin.—**A. Malicki**: Changes in relief of the terrestrial globe.—**Mlle. A. Cehak**: The quantitative determination of the deformations of the longitudinal profiles of the water courses of Pokucie.—**H. Bolkot**: The hypsographic curves of North America and of South America.—**J. Wiertelak**: The influence of white rot on the chemical composition of wood. White rot causes considerable losses of lignin, together with a slow decomposition of the carbohydrates. The loss of weight is marked, amounting in one case to 15 per cent.—**E. Pischinger**: The phosphorus compounds of plants (7). The solubility of the phosphorus compounds of hemp seed.—**L. W. Wisniewski**: *Cyathocephalus truncatus*, its development, morphology and biology.—**L. W. Wisniewski**: Two new progenetic trematodes of the Balkan Gammarideæ.—**Mlle. J. Ackermann**: The innervation of the skin of the frog (*Rana esculenta*).—**Mlle. J. Janiszewska**: Studies on *Aphidius*, a hymenopteran parasitic on the aphis *Hyalopterus pruni*.—**Mme. N. Natanson-Grodzinska**: The structure of the tegument of the aquatic larva *Cataclysta lemnata* and its function in respiration.—**Z. Grodzinski**: Observations on the lymphatic system of *Myxine glutinosa*.—**L. Sedlaczek-Komorowski**: Man of the age of the caliciform vases in Poland.

VIENNA

Academy of Sciences, June 16.—**Leonore Brecher**: Butterflies (*Vanessa Jo.* L.) direct from caterpillars. Of ten of these caterpillars, eight formed chrysalides and butterflies in the usual way, whilst the other two kept under the same bell-jar gave rise directly to stunted butterflies.—**Karl Huttrer**: Means for the analysis of the formation of butterfly markings. From observations made, it is concluded that neither the assumption of sensitive states nor the retardation theory suffices to explain the action of external factors on the formation of these markings.—**Erich Murr**: Direct dependence of the tail-length of the ferret (*Putorius furo* L.) on the temperature. The increased rectal temperature observed with pregnant ferrets kept at a temperature higher than usual is accompanied by increase in the length of the tails of the offspring.—**Hans Przibram**: (1) Regeneration of feelers and legs with phasmids (VIII): Attempts to find conditions for orthomorphic, heteromorphic or defective growth after removal of the feelers of *Dixippus morosus* Br. et Redt.—(2) Growth of appendices in allied locusts (*Sphodromantis, Mantis*).—(3) The 'lower' males of the rhinoceros beetle, *Oryctes nasicornis* L. as heat-forms.—**Toshihiko Yamanôuti**: Coprometry for the measurement of the growth of Orthoptera.—**Kasimir Graff**: The photometric system of the Holetschek nebula catalogue.—**Fritz Kerner-Marilaun**: Anisothermy in spring horizons and its geological significance.—**K. W. F. Kohlrausch, H. Kopper** and **R. Seka**: The Raman spectrum of organic substances (isomeric paraffin derivatives, ii). Secondary butyl alcohol, isobutyric acid, tertiary anyl iodide, and nine isobutyl derivatives, $(CH_3)_2 . CH . CH_2X$ ($X = CH_3$, OH, NH_2, SH, Cl, Br, I, NO_2 and NO_3), have been examined. The results show that, in a polyatomic molecule, RX, a physical meaning is attached to the valency frequency $C-X$, if the substituent X differs markedly in weight from the other groups—CH_3, CH_2—of the substituted paraffin.—**A. Dadieu, K. W. F. Kohlrausch**, and **A. Pongratz**: The Raman spectrum of organic substances (isomeric paraffin derivatives, iii). The results furnished by isoamyl and secondary butyl derivatives, in conjunction with those previously obtained, serve for the determination of the frequencies of the valency vibration of the carbon-halogen linking. Duplication of these valency frequencies occurs only and always if the molecule is able to assume different space-forms owing to free rotation. The frequency is related to the number of hydrogen atoms attached to the carbon atom of the carbon-halogen linking.—**Gustav Beer**: The convexibility of regular curves.—**Erich Haberfelner**: The history of the development of the monograptids.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, vol. 18, 409–480, No. 6, June 15).—**P. Debye** and **F. W. Sears**: On the scattering of light by supersonic waves. (See NATURE, vol. 130, 281, Aug. 20, 1932).—**Linus Pauling** and **Don M. Yost**: The additivity of the energies of normal covalent bonds. A normal covalent bond is defined as that between two unlike atoms of the same degree of negativity, and it is postulated that the energies of such bonds are additive. Experimental data of other workers is in fair agreement with this hypothesis.—**Marston Taylor Bogert** and **Torsten Hasselström**: Investigations in the retene field (2). Alpha-retene carboxylic acid and some of its derivatives.—**F. E. Lloyd** and **T. Cunliffe Barnes**: Changes in the cells of *Spirogyra* associated with the presence of water polymers. Ice water from ice formed over running water and also newly condensed steam were used in series of experiments on *Spirogyra nitida*, with and without the addition of nutritive salts in the form of Knopf's solution. Ice water, which contains much trihydrol, promotes reproductive activity at room temperature, as well as at 10° C. as reported previously. In the presence of Knopf's solutions, the filaments became tightly coiled in addition, indicating a high state of vigour.—**Edgar Anderson**: Character recombination in *Drosophila*. Regarding recombination of genes as a recombination of 'strings of beads' the lengths of which depend on the lengths of the cross-over segments, the effect of length and number of such 'strings' should be morphologically demonstrable.—**M. Demerec**: Effect of temperature on the rate of change of the unstable miniature-3 gamma gene

of *Drosophila virilis*. Observations on flies reared at 20°, 25° and 30° respectively suggest that at the higher temperatures, the character is more stable; the result is due, however, to the decreased size and crumpled wings produced. The frequency of change is independent of sex although the female carries approximately twice as many 'miniature' genes as the male.—C. R. Burnham: An interchange in maize giving low sterility and chain configurations.—R. A. Brink and D. C. Cooper: (1) A strain of maize homozygous for segmental interchanges involving both ends of the *P-br* chromosome.—(2) Chromosome rings in maize and *Œnothera*. The hypothesis of simple segmental interchange, although giving a satisfactory explanation of the chromosome attachments in *Œnothera*, does not account for those in maize. Other mechanisms are suggested and discussed.—E. B. Fred: The stability of physiological characters of bacteria. Cultures of nitrogen-fixing bacteria, lactic acid bacteria and tubercle bacteria kept in the laboratory for various periods up to twenty years and tested from time to time have shown no appreciable change in character.—Harry Merrill Gehman: Concerning sequences of homeomorphisms.—Edward V. Huntington: An improved equal-frequency map of the normal correlation surface, using circles instead of ellipses. Concentric circles and a family of equally spaced radial lines are drawn, forming a 'cobweb' map which divides the plane into 'townships of equal frequency'. From this map it is possible to make a direct comparison between the observed distribution of dots and the theoretical distribution in the corresponding normal case.—A. W. Tucker: Modular homology characters.—G. A. Miller: Orders for which a given number of groups exist.—Edward Kasner: Geometry of the heat equation: first paper. Heat curves are defined as the loci of constant temperature throughout a given flow of heat.

Forthcoming Events

TUESDAY, OCT. 11

ILLUMINATING ENGINEERING SOCIETY.—Lieut.-Commander H. T. Harrison (Presidential Address) at the Lighting Service Bureau, 15 Savoy Street, Strand, W.C.2, at 7 P.M.

INSTITUTE OF EDUCATION, LONDON.—Prof. C. H. Becker: "Educational Problems in the Far and Near East", at 5.30 P.M. (succeeding lectures on Oct. 12 and 13).

KING'S COLLEGE, LONDON.—Dr. J. W. Pickering: "Blood Plasma and Platelets", at 5 P.M. (succeeding lectures on Oct. 18, 25, and Nov. 1).

THURSDAY, OCT. 13

KING'S COLLEGE, LONDON.—Dr. W. Robson: "The Metabolism of Carbohydrates, Fats and Proteins", at 5 P.M. (succeeding lectures on Oct. 20, 27 and Nov. 3).

FRIDAY, OCT. 14

LONDON HOSPITAL MEDICAL COLLEGE.—Mr. S. P. Bedson: "Some Recent Work on Filterable Viruses and its Significance", at 5 P.M.

Official Publications Received

BRITISH

Committee of Enquiry on the Post Office, 1932: Report. Pp. 42. (London: H.M. Stationery Office.) 9*d*. net.

The Hundred and Tenth Report of the Commissioners of Crown Lands. Pp. 39. (London: H.M. Stationery Office.) 2*s*. net.

Transactions of the Optical Society. Vol. 33, No. 5. Pp. 189–251 + xiii. (London: Optical Society.) 10*s*.

The Newcomen Society for the Study of the History of Engineering and Technology. Transactions, Vol. 10, 1929–1930: with Index to Vols. 1–10. Pp. xii + 153 + 48 + 19 plates. (London: Science Museum.) 20*s*.

London County Council: Lectures and Classes for Teachers. Handbook for the Session 1932–33. Pp. 72. (London: London County Council.)

University of Reading: The National Institute for Research in Dairying. Annual Report for the Year ending 31st July, 1931. Pp. 90. (Reading.)

Allahabad University Studies. Vol. 8, Part 1 (Arts Section). Pp. iv + 252. 7.8 rupees. Vol. 8, Part 2 (Science Section). Pp. v + 231 + 19 plates. 7.8 rupees. (Allahabad: Indian Press, Ltd.).

Union of South Africa: Department of Agriculture. Science Bulletin No. 106: South African Tanning Materials (Part 3). By C. O. Williams. (Division of Chemistry Series, No. 122.) Pp. 92. (Pretoria: Government Printer.)

Newcastle-upon-Tyne Public Libraries Committee. Local Catalogue of Material concerning Newcastle and Northumberland as represented in the Central Public Library, Newcastle-upon-Tyne. Pp. vii + 626 + 1 plate. (Newcastle-upon-Tyne: Andrew Reid and Co., Ltd.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1932, Vol. 44, No. 7, August. Pp. 323–374 + xxviii. (London.)

Economic Advisory Council: Committee on New Industrial Development. Report. Pp. 29. (London: H.M. Stationery Office.) 6*d*. net.

Journal of the Chemical Society. August. Pp. iv + 2089–2284 + x. (London: Chemical Society.)

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1932–1933. Pp. 98. (Edinburgh.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1358 (Ae. 489—T. 2884 and "a"): Eddy Systems behind Discs. By T. E. Stanton and Dorothy Marshall. Pp. 11 + 6 plates. (London: H.M. Stationery Office.) 1*s*. net.

Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust. Report for 1931. Pp. 199. (Harpenden.) 2*s*. 6*d*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 25: *On the Cultivation in Artificial Media of Catenaria anguillulæ*, a Chytridiacean Parasite of the Ova of the Liver Fluke, *Fasciola hepatica*. By Prof. J. Bayley Butler and Annie Humphries. Pp. 301–324 + plates 13–18. 5*s*. Vol. 20 (N.S.), No. 27: A Comparison of some European and American Virus Diseases of the Potato. By Dr. Paul A. Murphy and Robert McKay. Pp. 347–358. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Dominion of Canada: National Research Council. Report No. 26: Survey of the Prairie Provinces. By J. M. Manson. Pp. 34. Report No. 27: Weeds and their Control. By G. P. McRostie, L. E. Kirk, G. Godel, W. G. Smith and J. M. Manson. Pp. 15 + 2 plates. (Ottawa: F. A. Acland.)

FOREIGN

Publications of the Lick Observatory. Vol. 18: A General Catalogue of the Radial Velocities of Stars, Nebulæ and Clusters. By Joseph Haines Moore. Pp. xvi + 220. (Berkeley, Calif.: University of California Press.)

United States National Museum. Bulletin 100: Contributions to the Biology of the Philippine Archipelago and adjacent Regions. The Philippine Land Mollusks *Cochlostyla rufogaster* and *Obba marmorata* and their Races. By Paul Bartsch. Pp. 327–342 + plates 83–86. (Washington, D.C.: Government Printing Office.)

Japanese Journal of Mathematics. Transactions and Abstracts, Vol. 9, No. 1. Pp. 86. (Tokyo: National Research Council of Japan.)

The Science Reports of the Tôhoku Imperial University. First Series (Mathematics, Physics, Chemistry), Vol. 21, No. 2. Pp. 193–297. (Tokyo and Sendai: Maruzen Co., Ltd.)

Proceedings of the United States National Museum. Vol. 81, Art. 14: Two New Land Shells of the Genus Bulimulus from Bolivia. By William B. Marshall. (No. 2937.) Pp. 3 + 1 plate. (Washington, D.C.: Government Printing Office.)

Carnegie Institution of Washington. Publication No. 434 (Paper No. 38 of Department of Genetics): Anthropometry of Adult Maya Indians; a Study of their Physical and Physiological Characteristics. By Morris Steggerda. Pp. v + 101 + 8 plates. (Washington, D.C.: Carnegie Institution.)

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 695: Surface Water Supply of Hawaii, 1st July, 1928, to 30th June, 1929. Pp. v + 101. 10 cents. Water-Supply Paper 697: Surface Water Supply of the United States, 1930. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. vii + 249. Water-Supply Paper 709: Surface Water Supply of the United States, 1930. Part 12: North Pacific Slope Drainage Basin. C: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. vi + 160. 15 cents. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Geological Survey. Professional Paper 161: Quaternary Geology of Minnesota and Parts of Adjacent States. By Frank Leverett; with Contributions by Frederick W. Sardeson. Pp. v + 149. Professional Paper 170–E: The Geologic Importance of the Lime-Secreting Algæ, with a Description of a New Travertine-forming Organism. By Marshall A. Howe. (Shorter Contributions to General Geology, 1931). Pp. 57–69 + plates 19–23. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Office of Education. Bulletin, 1932, No. 13: Record of Current Educational Publications, January–March 1932. Pp. vi + 108. (Washington, D.C.: Government Printing Office.) 10 cents.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 9, No. 2, August, Research Papers Nos. 461–470. Pp. 115–276. (Washington, D.C.: Government Printing Office.)

Rubber Research Institute of Malaya. Planting Manual No. 4: Latex Preservation and Shipment. By R. O. Bishop and R. G. Fullerton. Pp. 70. (Kuala Lumpur.) 2*s*.

Federated Malay States. Annual Report of the Department of Agriculture, S.S. and F.M.S., for the Year 1931. By Dr. H. A. Tempany. Pp. ii + 56. (Kuala Lumpur.)

SATURDAY, OCTOBER 15, 1932

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Post Office Reform

WE do not know whether it was mere coincidence or good stage-management that Lord Wolmer's book on "Post Office Reform" (Ivor Nicholson and Watson, Ltd., 6*s*. net) was published a week before the report of the Committee of Enquiry on the Post Office (Cmd. 4149. H.M. Stationery Office, 9*d*. net). However this may be, no study of the findings of that Committee can avoid reference to Lord Wolmer's campaign since he ceased to hold office as Assistant Postmaster General, for it was his persistence, supported ultimately by more than three hundred members of Parliament of all parties, which led directly to the appointment, by the present Government, of Lord Bridgeman and his colleagues, Sir John Cadman and Lord Plender, as a Committee "to enquire and report as to whether any changes in the constitution, status or system of organisation of the Post Office would be in the public interest".

Criticism of governmental administration is no modern diversion, and the Post Office, like other great departments of State, has not escaped the baiting to which 'bureaucracy' is always liable to be subject from those who as a matter of principle abhor State intervention, particularly in the sphere of commerce. Nevertheless, as a result of the reforms associated with the name of Rowland Hill, the attitude of the public towards the Post Office, personified in that popular character the postman, has been not unfriendly. The speed and accuracy of its letter-carrying activities and the extent of at any rate the pre-War facilities as regards deliveries and collections indeed left little to be desired.

Serious criticism of the Post Office only began to arise after the Office, in 1912, became solely responsible for the administration of telephone services, and it is the relative backwardness of telephone development in Great Britain in comparison with other countries, coupled with a certain administrative inelasticity, that has supplied the real driving force of Lord Wolmer's campaign. On one hand, as Lord Wolmer insists, it is a fact that the number of telephones per thousand of population is lower in Great Britain than in most other countries; that this feature is also apparent if large cities at home and abroad are compared; and that such telephones as are installed are less used than those in other countries. On the other hand, it is equally an undoubted fact, to which the Bridgeman Committee pays handsome

testimony, that the Post Office engineers have led the way in technical development in telephony and, we may add, in electrical communications generally. Yet with this tremendous advantage of an able and alert, if underpaid, technical staff, foremost in promoting the development of this highly technical industry, there has been, rightly or wrongly, widespread public dissatisfaction with the telephone service. If such dissatisfaction had not existed, it would have been impossible for Lord Wolmer's campaign to gather the necessary momentum to lead the Government to appoint the Bridgeman Committee of Enquiry.

The report of the Committee summarises as follows "the rather generalised charges" that have been made :—

(1) An absence of the spirit of public service, among certain sections of the staff—an attitude of indifference instead of a desire to help the public.
(2) A lack of initiative and an absence of elasticity and imagination in adjusting service to meet the reasonable variations in the public demand; prompt action is thought to be hampered by 'red tape' and dilatory procedure.
(3) In general an absence of the commercial outlook necessary for the efficient conduct of what is, at any rate to a large extent, a business concern.
(4) A failure in regard to the telephone and telegraph services which are of a highly technical character, to give proper scope to the engineer, whereby technical progress is impeded.

This summary may to some extent be taken as reflective of the criticisms of Lord Wolmer, who argues that the telephone and telegraph services have not been administered on commercial lines because they have been administered by a Government department organised on the traditional Whitehall basis, with all that such organisation necessarily involves in rigidity of administration, owing to day-to-day accountability to Parliament in regard to the minutest details; inability to take normal commercial risks as a result of financial control by the Treasury; and above all in the arrangement, copied from Whitehall, under which all sub-departments come to a narrow bottleneck at the Secretary of the Post Office, so rendering promptness of decision impossible.

In the controversies generated by Lord Wolmer's campaign, the serious questions of organisation involved have tended to become obscured by political factors. The fundamental issue has been represented to the public as being primarily one of the respective merits of public and private enterprise; and to overcome the weaknesses of Post Office administration, reformers have offered us a choice between the transfer of the Post Office communications services either to a public board on the model of, say, the Port of London Authority, or to a public utility company analogous to the Imperial and International Communications Company Limited, which is now responsible for all international wireless telegraph services originating in Great Britain. Unfortunately, the form which the public controversy has taken has caused certain essential elements of the problem to be overlooked, especially the obvious but all-important fact that, although for historical reasons the postal, telegraph and telephone services have become closely interlocked, the industrial structure of the Post Office, as regards electrical communications, is very largely, indeed almost entirely, the fashioning of scientific discovery and invention. The telegraph and telephone services are dependent, to a much greater degree than are the mail-carrying services, upon research and technical progress. No change of ownership or control which fails to take account of this fundamental fact is likely to achieve the desired results.

These considerations are by no means novel, for they were in the minds of that somewhat unpromising body the Select Committee on the Telephone Service, appointed so long ago as 1922 "to inquire into the organisation and administration of the telephone service and the method of making charges". That Committee emphasised that telephone business is essentially commercial and must be *administered on commercial lines*. It pointed out that the carriage of letters has always been upheld as the main foundation on which Post Office management rests, and when the telephone and telegraph undertakings were in turn transferred to the Post Office, "it seems to have been decided to patch them into the existing organisation rather than to alter the organisation to suit the extended conditions". The Committee recommended, therefore, the separation of the telephone and telegraph services from the mails. It also pointed out that "the Secretary's Department at the General Post Office, which really controls it, has neither special business training other than that of the ordinary Civil Service, nor special expert and technical qualifications", and it hinted at the desirability of the establishment of an administrative board

for the control of the segregated telephone and telegraph services. Finally, the Committee insisted that greater weight should be given to technical knowledge both in settling policy and in ordinary routine.

The Bridgeman Committee again and again throughout its report pays tribute to the zeal and ability with which the Post Office staffs carry out their duties. Yet the Committee is constrained to state that the criticisms of the telephone service "are not devoid of some substance", and that it believes that "there is room for improvement", but that "such improvement can only come from a removal of certain fundamental impediments to efficiency". These fundamental impediments are considered to be the relationship in which the Post Office stands as a revenue department to the Exchequer, and the internal organisation of the Post Office. The Committee, however, rejects the transference of all Post Office communication services to an independent authority of the public utility company or statutory corporation type, for it considers that "the public have a right to the influence which Parliamentary discussion and control alone can give". The proposal for the transference of electrical communications to an independent authority is also rejected. It is admitted that there might be advantages in this course if it were a question of inaugurating for the first time in Great Britain a new system of communications, but the Committee makes a point of considerable importance which, it must be admitted, has the force of expediency. Under present conditions, in all but the largest offices, the counter staff now deal indiscriminately with all kinds of business, and in all the smaller towns the sorting and telegraph operating staffs are combined to good effect, since the 'peak' hours of postal work are usually outside those of telegraph business. Separation, in the view of the Committee, "would entail large additional expense and would result in two separate organisations, neither of which would be carrying a full load."

Limitations of space prevent us from dealing with the first of the above-mentioned impediments to efficiency. We need only say that, in the view of the Committee, "In the present state of the National finances it would be impracticable to suggest any other principle than that the Exchequer should retain out of the net revenue collected by the Post Office a sum approximating to the amount which it is at present receiving."

As regards the second fundamental "impediment to efficiency", namely, the system of administrative control at the Post Office itself, the Committee is more drastic. It considers, in the first place, that there is far too much centralisation of staff management at headquarters and too little freedom left to the local officer in the provinces. It believes that much of the dissatisfaction with the telephone system is due to the general diffusion of responsibility and absence of co-ordination between those concerned with the various elements involved in the provision and conduct of the service. There is, the Committee says, "no one authority who can deal with complaints or ensure that orders are promptly and satisfactorily executed". The District Manager, who is, broadly speaking, responsible for the telephone service in his area, has no jurisdiction over the engineering and little disciplinary control over the operating staff. The Committee states that the District Manager is also handicapped by the restriction of his executive authority and is subjected in such matters as publicity, canvassing, etc., to rigid control by headquarters on matters of outlay and method, which tends to repress zeal and initiative as well as to waste time and money.

The Committee proceeds to remark that the Post Office Secretariat "has come to acquire a status out of proportion to that of other Post Office departments"; no executive department of the Post Office can give an instruction to another department, nor can it through its own officers do anything for which it has not Secretariat authority. The present position of the Secretariat, it is stated, "contravenes the fundamental principle of organisation, namely, the distinction between policy and practice, between the administrative and the executive functions". The Committee considers that the neglect of this important distinction is one of the main weaknesses of the existing Post Office organisation, and it arrives at the same conclusion as the Select Committee of 1922 that the Secretariat, as at present constituted, is unsuited by training and experience for the duty of conducting the daily business of the Post Office services, which function it undertakes in addition to the framing and formulation of policy. It is noted too that, owing to the "autocratic isolation of the Secretariat", the Engineering and Accountant General's Departments are prevented from taking an adequate part in the general scheme of control, and although the Committee considers there is no evidence that the engineer is unduly

hampered, it believes that engineering experience is insufficiently brought into the consideration and formulation of general policy.

Such serious defects demand radical treatment, and the Committee recommends that the control of all Post Office business shall be taken out of the hands of the Secretariat and effected through the medium of a functional Board, presided over by the Postmaster General. In addition to the Assistant Postmaster General the Board should, it is suggested, comprise four or five members of the Post Office staff representing such functions as general operating and supply, engineering and research, finance, and personnel. In the absence of the Postmaster General the Board would be presided over by the senior permanent member, who would carry some such title as 'Director General', and whose duty it would be to ensure that Board decisions were made effective, that continuity and unity of policy were maintained, and that the general machine of administration worked smoothly and effectively. The duties of the Board would, so far as possible, be restricted to the consideration and formulation of policy, leaving to the heads of the district organisation the duty of translating into effect the policy prescribed by the headquarters board. In the provinces it is recommended that the local administration should be controlled by regional directors who would constitute the co-ordinating authority for their respective regions and whose organisation would in effect be a reproduction in miniature of the headquarters board. It is in the application of this recommendation that controversy is not unlikely to arise, for the engineers in each district, hitherto autonomous, would thus come under the local control of a regional director, who might or might not be a 'telephone' man.

Other vital recommendations are that the existing division between the Secretariat and the rest of the staff should be removed and fluidity of interchange of staff between headquarters and the provinces secured. The Committee proceeds to make the long-awaited recommendation from a public inquiry: "As regards access to administrative posts, we consider that there should be no bar to a technical officer holding such posts, provided he has shown himself to possess administrative ability." With regard to the problem of the technical expert, the Committee considers it essential in an organisation such as the Post Office, which depends so much upon scientific discoveries and developments and their practical applications, to bring engineering and research into more intimate touch with the general problems of administration.

In its appreciation of the fundamental weakness of present-day Civil Service administration the Committee has rendered an important public service. That the higher administrative posts in Government departments are commonly held by individuals of exceptional ability cannot be challenged, but a system under which almost autocratic powers of control and the monopoly of the formulation of policy are solely vested in individuals who may have no knowledge of or sympathy with scientific and technical developments can only be described as a national menace; for what the Bridgeman Committee has discovered in the Post Office can equally be said *mutatis mutandis* of most of the larger departments of State. The remedy proposed—the introduction of the Board system, under which departmental chiefs, both technical and non-technical, would be given a full opportunity of taking their proper share in the formation of policy—is one we have consistently advocated. The Committee's recognition of the importance of the expert and of the folly of debarring him irrespective of his administrative capacity from positions of control is of first importance. The divorce between the administrator and the technologist, the failure to achieve anything like a complete synthesis of the administrative and technical sides, is not peculiar to the Post Office in particular or to government departments in general. It characterises far too many business and industrial organisations.

In a paper read last year during the centenary meeting in London of the British Association for the Advancement of Science, Major L. Urwick, the director of the International Management Institute, Geneva, pointed out that throughout the century of the life of the British Association, despite the immense services which the inductive sciences are rendering to industry, it apparently has never occurred either to industrialists or to men of science that these services are other than contributory or ancillary. The Bridgeman Committee is the first public inquiry committee to give full recognition to the scientific expert in the Civil Service scheme of things. What it proposes amounts in sum to this, that the scientific expert is to be brought into the industrial family on level terms with the administrative expert and the financial expert and to have his due say as well in the formulation of policy as in the control

and execution of the routine operations. There is no suggestion that the business of the Post Office should be turned over entirely to the technologists. Viscount Bridgeman and his colleagues say sensibly: "Generally speaking we think it to be true that the specialist in any walk of life tends to remain a specialist; but there are, of course, well-known exceptions to the contrary, and we consider that where a member of the technical staff has shown that he possesses administrative talent he should be eligible for other appointments." No champion of the scientific worker in industry need ask for more than this or should be satisfied with less. The recommendation of the Bridgeman Committee, "to bring engineering and research into more intimate touch with the general problems of administration" is to be welcomed, not only for the beneficial effects which, if it is adopted, it is likely to have on the development of the Post Office, but also, and perhaps especially, for the stimulus it may give to the wider movement to bring about a closer fusion of science and industry and to get the scientific worker fully adopted into the industrial family.

Anthropology in Nigeria

Tribal Studies in Northern Nigeria. By C. K. Meek. Vol. 2. Pp. viii + 633 + 48 plates. (London: Kegan Paul and Co., Ltd., 1931.) 25*s.* net.

IN this work Mr. Meek apparently concludes his valuable notes on some of the smaller and lesser known peoples of Northern Nigeria—more than a score in all. As in the first volume (see NATURE, vol. 128, p. 285; 1931) chief attention has been paid to linguistics and social organisation and little to religion, which in the main consists of animism and ancestor worship. Each tribe is dealt with separately, and no attempt is made to give a general description of any particular custom or belief—doubtless the wisest course to pursue until more information has been collected.

One of the immediate practical advantages to be gained from these studies is that it should now be possible to group these peoples more scientifically; at present the Katab, for example, are not only divided by provincial boundaries, but also some of them are directly administered by British officers, while others are under Fulani emirs. One of the chief defects of indirect rule, as practised in Northern Nigeria, lies in the fact that so many pagan tribes have no native courts of their own but are subject to the judicial administration of Mohammedan alkalis.

Most of the peoples under consideration are of ancient semi-Bantu origin and possess interesting features in the way of totemism, exogamy and mother-right organisation. As is usual in Nigeria, totemism is mixed up with metamorphosis and is now fast breaking down. There is a certain amount of evidence for the belief that clan exogamy—at any rate in this region—arose from a desire to avoid local conflicts, and has nothing to do with consanguinity or the hypothetical unattractiveness of the woman whom you see every day; among the Piti, for example, intermarriage is most usual between those 'wards' which are nearest to one another. Fundamentally, no man may marry a woman of his own clan but, as the sense of kinship with the parent community dwindles, the exogamic taboos become confined to the new group.

There are examples of all stages of development, from the mother-right Longuda to the Kanakuru, who are mainly patrilineal though matrilineal in totemistic affairs, and the wholly patrilineal Bornuese tribes. Marriage is often matrilocal, and the children may be handed over to the mother's relatives, though occasionally to those of the father.

Until lately, marriage by capture was quite usual and traces of the custom are found in most tribes. One of the commonest methods of obtaining a wife is that of elopement with a married woman from another group or clan—a transaction previously regularised by payments to her family. This practice is apparently recommended, since it gives each party the opportunity of finding the one who suits him, or her, best; the original marriage is generally arranged at a very early age, sometimes even before the girl's birth. Children begotten of the second husband, as a rule, belong to him, but he cannot claim the return of his dowry should the woman leave him in turn, while the first husband practically never does so, as he always lives in the hope of her coming back to him.

Indeed, the position of women here, as in so large a part of West Africa, is highly enviable. The man is always anxious to gain, or keep, the services of at least one wife to cook for him; among the Gabin, where the women make the beer, they do not hesitate to dictate as to the friends who are allowed to partake of this, and even to forbid their husbands to attend a neighbouring celebration, if they consider that these would be better employed at home. The husband must continue to pay court not only to his wife,

but also to her maternal relatives, else they may transfer her to another suitor. The more attractive she is—and it is of interest to note that among the Kanakuru slimness is considered a beauty—the greater efforts must be made by him to counterbalance those of his would-be rivals. In fact, many husbands may be said to spend most of their time in endeavouring to retain their wives or in working out plans to obtain the wife of some one else.

The birth of a child before the mother's cicatrisation ceremonies have been carried out among the Yungur and Kona Jukun—or, with the Hona and Gabin, before the ordained time—is a serious offence; the consequences are usually avoided by abortion. A Katab woman marks each month of pregnancy by putting a circular dot of red earth on her thigh, while the husband keeps his own private tally in case his wife runs off before giving birth to the child.

Mr. Meek's volume is profusely illustrated, but the index would be of much more use if it were fuller; at present, if it is desired to look up, say, a certain fact about the Fulani, it may be necessary to go through the whole fifty-three references under this heading.

P. AMAURY TALBOT.

Poesy in Combustion

A History of Fire and Flame. By Oliver C. de C. Ellis. Published for the Poetry Lovers' Fellowship with the International Fellowship of Literature. Pp. xxiv + 440 + 20 plates. (London: Simpkin Marshall, Ltd., 1932.) 15*s*. net.

A PROBLEM that the alchemists found extremely difficult to solve was the preparation of an amalgam of iron. Dr. Ellis has attempted an analogous task, namely, the fusion into a homogeneous unity of the cold and hard scientific facts of the history of fire with the æsthetic appeal of fire and flame to his poetical emotions. The result is a book *sui generis*, which will be variously estimated according to the point of view from which it is surveyed. It is scarcely within the province of the present reviewer, and still less within his capacity, to appraise its merits as a work of art, though Dr. Ellis's mellifluous prose and well-developed sense of style must afford pleasure even to the most Philistine of his readers. The book is, however, by no means easy to understand, partly because the author's fancy leads him to stray down every attractive by-path, and partly because his wealth of quotation and allusion is apt to prove bewildering to anyone less familiar than himself with the original literature.

While every topic relevant to fire and flame—from the unicorn and the phœnix to the history of lucifer matches—is fitted neatly into the pattern, the pattern still remains somewhat kaleidoscopic, and the main arguments consequently have to be discovered by a process of induction. It is only just to add that the process is well worth undertaking, for Dr. Ellis's ideas are often highly original and frankly opposed to many opinions now generally accepted. Indeed, judged as a scientific history of certain fundamental chemical discoveries, the book demands serious attention.

One of the principal theses is that "the prime secret of the alchemists was oxygen". It is, of course, undeniable that oxygen must have been liberated on innumerable occasions during the progress of alchemical operations; but the same statement is equally true of hydrogen, hydrogen sulphide, hydrogen chloride, carbon dioxide, carbon monoxide, ammonia, and nitrogen peroxide, so that one turns with interest to see how the thesis is supported and what value is to be assigned to the evidence adduced. Such an examination makes it only too clear that Dr. Ellis is rather easily satisfied. He first assumes that the alchemists were able to collect oxygen by heating 'nitre'. It is possible—indeed, it is practically certain—that the early alchemists used potassium nitrate, but for the most part 'nitre' or 'nitrum' was applied to naturally occurring sodium carbonate, and a sharp distinction between the latter and the substance we now call nitre was not drawn earlier than the thirteenth century.

When Dr. Ellis says that "the earliest historians, geographers, and technicians speak of vast alluvial deposits" of nitre, that is, potassium nitrate, he is misinterpreting the sense of the Latin *nitrum*, which here signifies *natron*. Again, he quotes Virgil: "I have seen many sowers artificially prepare their seeds and steep them first in saltpetre and black lees of oil". He does not give the reference, but presumably the passage is that in the "Georgics", i. 193-196:

semina vidi equidem multos medicare serentes,
et nitro prius et nigra perfundere amurga,
grandior ut fetus siliquis fallacibus esset,
et, quamvis igni exiguo, properata maderent.

There is nothing in this description to suggest that by *nitrum* Virgil meant saltpetre; on the other hand, natron would fit the context, since it appears to have been believed by the Romans that plants

grown from seeds treated in this way would be softer and greener on cooking. Pliny ("Historia Naturalis", xxxi. 115) says that *nitrum* was used in cooking vegetables to give them a greener colour: such *nitrum* could scarcely have been anything but soda. Further, Dr. Ellis says that "nitre was a familiar weapon of the medieval chemist, in whose mind it was associated with fire as naturally as air was". What limits he sets to the Middle Ages he does not say, but in any event such a sweeping generalisation needs a good deal more documentary evidence than he is able to bring forward.

There are several other points in which Dr. Ellis's accuracy is far from unimpeachable. Thus he complains that there is no English translation of Mayow's "Five Treatises" (which he describes as "an amazing pack of nonsense"), though an excellent translation was published in the Alembic Club Reprints (No. 17) in 1907; he attributes the celebrated generator to Kipps instead of to P. J. Kipp (1808–64); he equates the alchemical 'tinctures' to 'slags'; and he says that the phlogistians conceived phlogiston as a palpable, substantial chemical 'sulphur'. Moreover, the passage from Paracelsus that Dr. Ellis takes to be a description of the preparation of phosphorus from urine is capable of interpretation in many other and much more probable ways; while the quotation from the "Demonolatry" of Nicholas Rémy does not carry conviction—at least to the reviewer—that phosphorus was known in 1588. Finally, Dr. Ellis's tentative identification of Eirenæus Philalethes (properly Philaletha) with Boyle has little to recommend it, in view of the fact that the only definite knowledge we have of this alchemical writer is that he was twenty-three years of age in 1645, when Boyle was eighteen.

In spite, however, of the too frequent carelessness shown in verifying references, and in spite of Dr. Ellis's tendency to credit the alchemists with more knowledge than they can be proved to have had, the "History of Fire and Flame" is a fascinating, informative, and beautiful book. No one who turns its pages will fail to catch some of Dr. Ellis's enthusiasm for his subject, or to experience (even if vicariously) some of his æsthetic emotion. There are passages of great poetic charm, and, equally, passages of keen historical insight, while flashes of dry humour sparkle in unexpected places and add a lively flavour to the whole. Nor, though his facts are not always above suspicion, is Dr. Ellis's critical judgment lacking. As Watson once wrote of a book of Nollet's, "he has traced the origin of several happy inventions, and has exhibited the real authors of them. He has given, as he imagines, additional value to several experiments which appear to have been too much neglected; and brought others which have been over-rated to their proper standard." Zoroaster would have no cause to be ashamed of this latest offering to the flame of his altar.

E. J. Holmyard.

Researches in Aerodynamics

(1) *Hydro- und Aeromechanik nach vorlesungen von L. Prandtl.* Von Dr. O. Tietjens. Band 2: *Bewegung reibender Flüssigkeiten und technische Anwendungen.* Pp. viii + 299 + 28 Tafeln. (Berlin: Julius Springer, 1931.) 23 gold marks.

(2) *Handbuch der Experimentalphysik.* Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 4: *Hydro- und Aerodynamik.* Teil 2: *Widerstand und Auftrieb.* Herausgegeben von Ludwig Schiller. Pp. viii + 443. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932.) 41 gold marks.

(1) Dr. Tietjens has performed a very valuable service in writing his two books, based on the lectures of Prof. Prandtl at Göttingen. This second volume deals mainly with the motion of viscous fluids, and the treatment of the subject follows the lines of Prandtl's lectures, but Dr. Tietjens has amplified certain sections, particularly those dealing with the flow in pipes and with the drag of symmetrical bodies, and has added a final chapter describing experimental apparatus and technique. The book contains perhaps little that is new to the student of the subject, and for the greater part it gives a critical descriptive account of the observed phenomena and the corresponding theory rather than the details of the theoretical analysis. The great merit of the book, however, is the excellent account of the physical basis of the boundary layer theory, of the significance of evanescent viscosity in determining the nature of the flow even when the surface friction itself is negligible, and of the fundamental principles underlying the theory of the lift of an aerofoil.

The chapters dealing with the flow in pipes, with boundary layers, and with the drag of symmetrical bodies are perhaps the most interesting and comprehensive; but exception must be taken to the statement that there is a laminar boundary layer below the turbulent flow over the surface of a body, since it rests solely on an attempt to apply rigidly the semi-empirical power law for the velocity

distribution of turbulent flow and is not in accordance with the actual physical conditions. The final chapter on experimental methods contains a brief historical account of the development of wind tunnels and a description of the various modern types. Particular attention is also devoted to the methods of making the flow visible, and there is an interesting series of photographs showing the development of turbulence behind a bluff body and of circulation round an aerofoil.

(2) This volume of the "Handbuch der Experimentalphysik" is devoted to the subject of the lift and drag of a body moving through a fluid, and more particularly to the experimental methods of measuring these forces. All the articles attain a high standard, being comprehensive in character and clear in expression, but it is perhaps to be regretted that experiments in flight, apart from deceleration tests of airships, receive only the briefest attention.

Flachsbart contributes an interesting historical account of the development of hydrodynamics, confined mainly to the determination of drag and the necessary experimental apparatus, and this is followed by an article by Prandtl on the design and operation of modern wind tunnels, in which he expresses a preference for the open jet type in spite of its poorer economy of power. Seiferth and Betz discuss the method of testing aeroplane models in a wind tunnel, describe the principal types of balance used in these tests, and give a few typical experimental results. The problem of wind tunnel interference is discussed in detail, but unfortunately there appears to be some misapprehension on the subject. The authors seem to assume incorrectly that the corrections in open and closed tunnels of any shape are of the same magnitude but opposite sign, and in discussing the interference on the downwash behind an aerofoil they fail to realise that the method of images remains valid for a rectangular tunnel, though it breaks down for a circular tunnel.

Muttray contributes an excellent account of the measurement of the drag of symmetrical bodies, both directly and by measurement of the flow in the wake, and he gives a critical account of the experimental results available. Dropping tests of spheres and discs are discussed very ably by Schiller, who concentrates on the lower range of Reynolds's number, whereas Muttray deals mainly with wind tunnel tests on a larger scale. Schiller also gives a critical discussion of the problem of the sphere, including a summary of the theoretical work on the subject, and shows that the most reliable experiments confirm the accuracy of Goldstein's extension of Oseen's solution with Faxen's correction for wall interference. The final article is devoted to the problem of lubricated bearings, and Kiesskalt gives a clear account of the subject, including a brief summary of the theory initiated by Reynolds and developed by Duffing.

Short Reviews

Introduction des théories de Newton en France au XVIII^e siècle avant 1738. Par Prof. Pierre Brunet. Pp. vii + 355. (Paris: Albert Blanchard, 1931.) 55 francs.

The eighteenth century witnessed the bitter controversies between the Cartesian and the Newtonian conception of the physical world. For decades, the Cartesians tried all the subtleties of logic and science to defend the vortex theory against the views based on universal attraction. But in the end, they had to give way; and the popular defence of Newton's philosophy by Voltaire marked the turning of the tide. It is the epic of these controversies which Prof. Brunet describes for us with a wealth of details giving a scholarly interest to his exposition. The opposition of the Cartesians can be explained by the fact that their master's theory was the first universal explanation of the world, independent of the occult forces which were in favour during previous centuries. The scientific atmosphere of the time was quite at ease with the mechanist conception of Descartes, and loathed any system which had even a vague resemblance to occult qualities. No doubt these controversies help to clear the implications of Newton's system of the dogmatic blemishes which had to be ultimately recognised in Descartes' cosmology. In bringing to light such and other important points, Prof. Brunet has rendered a great service to the history of science. T. G.

More Essays of Love and Virtue. By Havelock Ellis. Pp. xiii + 218. (London: Constable and Co., Ltd., 1931.) 7*s*. 6*d*. net.

Mr. Havelock Ellis began writing books more than thirty years ago, and some of his books might be described as milestones on the way to a more scientific and therefore a saner outlook upon certain aspects of human life. He tells us that his earliest book, having first been received with howls of execration, is now called sane and reasonable. Here he writes again, as indeed he has always written, of love and virtue—meaning by these not crude sex and namby-pamby goodness, but something heroic. He writes of the new mother, the renovation of the family, the function of taboos, the "revaluation of obscenity", the control of population, and the future of eugenics. Whether the reader agrees with Mr. Ellis or not, he feels himself in the hands of one who is master of his theme, and master also of a felicitous literary style. Few people, we imagine, could read the preface to these chapters without reading on to the end.

A World of Epitomizations: a Study in the Philosophy of the Sciences. By Prof. G. P. Conger. Pp. xiv + 605. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1931.) 22*s*. 6*d*. net.

THE progress of scientific philosophy seems to be based on rather peculiar assumptions. Run away from substance but hang on to structures, is the slogan that would characterise them best. Yet, in turning its back on Plato and Aristotle, scientific philosophy runs the risk of becoming finally a meaningless logomachy. This tendency seems to us to be interestingly illustrated in the book under review, in which the author, in order to explain structures by other structures, finds himself compelled to adopt a language of his own, to which one may easily take exception for the sake of clarity if not of value and truth.

It is a matter of convenience to divide the cosmos into the three realms of matter, life, and mind, and to discover in them parallel configurations ranging from simpler to more complex ones. But it seems to us misleading to call 'monads' the structures characteristic of each of these configurations. What the author calls "epitomization by monads or by analogy" is the classification of the various 'monads' according to their significant resemblances. This general methological frame enables him to marshal an amazing wealth of details and philosophical or scientific pronouncements into a convenient place in the development of our knowledge. In this he has perhaps performed a useful work, in so far as it enables us to see, almost at a glance, the possible connexion between sometimes widely different theories. But such an epitome of science scarcely explains science itself, which should be the object of philosophy. The hypothesis of epitomisation, if considered as a metaphysics, could not help us to advance one inch towards any philosophical results. "Synoptic naturalism", by which the author defines his position, is merely a term, and the few remarks made about it at the end of the volume are apt to kindle one's curiosity rather than to satisfy it. But perhaps the author does not mean to expound any metaphysics at all—at least, as it is understood in the Greco-Roman tradition.

Recent Advances in Botany. By E. C. Barton-Wright. Pp. viii + 287. (London: J. and A. Churchill, 1932.) 12*s*. 6*d*.

THE "Recent Advances" series of books published by Messrs. Churchill have made for themselves a definite niche in modern scientific literature. Such volumes, written by active scientific workers, must prove invaluable especially to advanced university students of the subjects concerned.

Botanical literature, even that in English, from the point of view of the keen student, has developed into such a maze that it is almost impossible to keep into close touch with all recent important discoveries.

This volume will help such students considerably. The subject matter, controversial though it may be, is presented fairly and references for further study are given at the end of each chapter. The recent theories of form and size are given a prominent position and modern views on palæobotany, species, Fungi, Algæ and virus diseases are considered. Coming from this author, one cannot restrain a feeling of disappointment at the meagre space allotted to plant physiology.

Despite several defects, especially with regard to choice of material (and even this is purely a matter of individual opinion) one can say that the book should be available to all advanced students of the subject.

Glastechnische Tabellen: Physikalische und chemische Konstanten der Gläser. Unter Mitwirkung von H. Alterthum, Chr. Andresen-Kraft, D. Badt, E. Berger, W. E. Flesch, M. Fritz-Schmidt, H. G. Frühling, B. Lange, G. Liebmann, T. Liepus, J. Löffler, M. Reger, A. Russ, R. Schmidt, J. Völker, W. Weyl. Mit besonderer Unterstützung der Deutschen Glastechnischen Gesellschaft E. V. Herausgegeben von Prof. Dr. Wilhelm Eitel, Prof. Dr. Marcello Pirani, Prof. Dr. Karl Scheel. Pp. xii + 714. (Berlin: Julius Springer, 1932.) 149·80 gold marks.

THIS volume of more than seven-hundred pages of summarised information must be admitted as a super-production. The very names of the three co-editors are sufficient to guarantee a book of eminence, and their long list of collaborators of standing is proof of the thoroughness with which the quickly growing literature on glass technology has been combed for data.

The book was planned in 1928, in which year it received the blessing of the Deutschen Glastechnischen Gesellschaft, since which time the editors and their colleagues must have been exceptionally industrious, for information has been collected from about 2500 original papers. It has been examined and sifted, only that which appeared sufficiently precise and reliable being included. Not a single paper containing information capable of being expressed by numbers or diagrams appears to have been overlooked.

The first section of three into which the book is divided, deals with the constitution of glass from the point of view of the 'phase' theory. Temperature-concentration equilibrium diagrams are given for all the systems that have been worked out. Though such diagrams cannot of course refer to true glasses, but only to devitrified glasses, they do help towards an understanding of the constitution of glass. In the second section, the whole range of physical properties—together with the chemical durability—are treated systematically. Where the compositions of the glasses, referred to in Section 2, are known with a sufficient degree of accuracy, they are included in and compose the third section. The usefulness of the book is increased by the inclusion at the end of each subsection of detailed references to the literature on the subject.

S. E.

Chemistry in Space

THE chief impression left by the first meeting of Section B (Chemistry) of the British Association at York on Sept. 1, was the soundness of the foundations on which stereochemistry has been built. After thirty years of revolution in our ideas of the nature of the physical world, the basic conceptions of chemistry need little modification and their assimilation into the body of the new atomic physics only gives them a clearer meaning and a wider usefulness.

This is well exemplified by the first of the two main themes to which Dr. W. H. Mills devoted his presidential address, namely, the value of the tetrahedral atom model when expressed in terms of the electronic theory of valency. The three dimensional extension of the octet theory can be simply represented in a diagrammatic manner by placing the four pairs of electrons at the corners of a tetrahedron concentric with the atom under consideration. Another atom, linked by a pair of electrons, will be situated on the axis through the corresponding axis of the tetrahedron. This tetrahedral octet can only be expected to give a general indication of configuration; since atoms are deformable and valencies can be deflected, it cannot be used, for example, to predict accurate values of intervalency angles. Qualitatively, however, it is able to represent the stereochemistry of all compounds formed in accordance with the octet rule.

When such compounds contain only links composed of two electrons, then it is invariably found that a four co-ordinate atom has a tetrahedral configuration, a three co-ordinate atom a pyramidal configuration, and a two co-ordinate atom an angular configuration. This is illustrated by the configurations of methane, ammonia and water in Fig. 1.

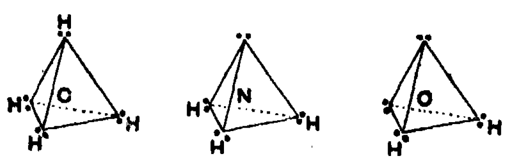


FIG. 1.

The tetrahedral type covers not only the familiar carbon compounds but also accounts for the optical activity of substituted ammonium ions of the type $[Nabcd]^+$, of amine oxides, and of four co-ordinate complexes of beryllium, copper and zinc. The pyramidal formula is, of course, in harmony with the structure of ammonia deduced from its dipole moment and infra-red spectrum; it also accounts naturally for the isomerism of the oximes, the optical activity of sulphoxides and sulphinic esters observed by Kenyon and Phillips, and for the recent resolutions of the *aci*-forms of secondary nitroparaffins. The latter are of particular interest since they probably contain a tri-covalent carbon atom with a pyramidal configuration. (Fig. 2.)

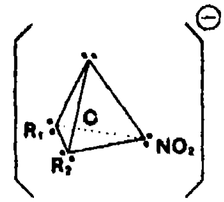
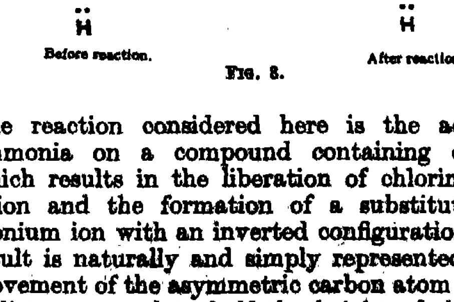


FIG. 2.

The outstanding difficulty in this group of compounds is the persistent failure to resolve amines of the type *Nabc*. Prof. J. Meisenheimer's contribution to the discussion was concerned mainly with this point; he showed that no resolution is obtained with compounds in which one of the nitrogen valencies is attached to oxygen, namely, in hydroxylamines and in quinoline oxide. Negative evidence of this kind may, as Sir William Pope remarked, have little or no significance and must be very cautiously interpreted; on the other hand, there is some spectroscopic evidence for the view that the nitrogen atom oscillates through the plane containing the attached groups and so makes it impossible to isolate an optically active product.

The idea of the movement of a critical atom to a new permanent position in the molecule was shown by Dr. Mills to give a simple and natural interpretation of three important stereochemical problems, namely, the Walden inversion, the *trans* elimination of water from aldoximes, and the *trans* Beckmann change. The mechanism by which the first of these changes is brought about can be represented very simply by the formulæ in Fig. 3.



Before reaction. After reaction.

FIG. 3.

The reaction considered here is the action of ammonia on a compound containing chlorine, which results in the liberation of chlorine as an anion and the formation of a substituted ammonium ion with an inverted configuration. This result is naturally and simply represented by the movement of the asymmetric carbon atom through a distance equal to half the height of the tetrahedron. The critical point in this explanation is, of course, the attack of the ammonia molecule on

the correct face of the tetrahedron, since attack at any other face would not give the inverted configuration. The electrostatic fields due to the dipole moments of the C—Cl link and the N—H link will give a directing effect and the movement of the carbon atom in this direction will most readily facilitate the escape of the chlorine ion. Thus the velocity of reaction at the proper face will be favoured and inversion will be almost complete.

The formation of benzonitrile from the β-form of benzaldoxime acetate is represented in Fig. 4. The essential reaction is the removal of the elements of acetic acid; this is brought about readily by the action of alkalis on the β-form in

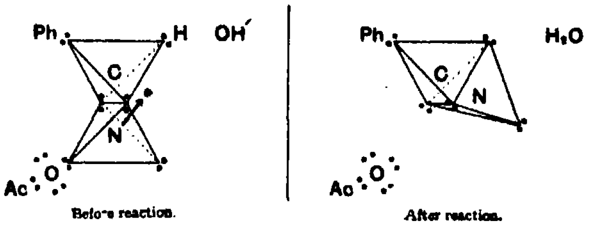


FIG. 4.

which the acetyl group and the hydrogen are on opposite sides of the molecule. The first step is the removal of a proton by union with a hydroxyl ion. The second is the movement of the nitrogen atom into line with the carbon atom to form the linear grouping of benzonitrile. This movement is directly away from the acetate group, which is, therefore, liberated as an ion. The movement of the nitrogen atom in the acetate of the isomeric α-oxime would not be in a direction away from the acetate group; hence the isomeride which reacts most readily must have the *trans* configuration in accordance with the modern view.

This conception of the movement of critical atoms gives a particularly neat explanation of the *trans* Beckmann change. It is usual to think of the migration of groups. If, however, we consider the change occurring in an isolated molecule and remember that moment of momentum must be conserved, it is clear that most of the movement by which the relative displacement is brought about would be executed by the nitrogen atom. Fig. 5 indicates the alternative movements of the nitrogen atoms corresponding with *cis*- and *trans*-migration, and show that the latter is much more probable. The driving force which brings about the change is probably the affinity of the oxygen for the central carbon atom. The first step would therefore be the attachment of the oxygen atom to this carbon atom, followed, or accompanied by the migration of the nitrogen atom. As the diagram shows, this could readily occur to give *trans*-migration, whilst *cis*-migration would involve the passage of the nitrogen atom across the line of closest approach of the oxygen atom to the central carbon atom. The *cis*-interchange of groups, instead of being an assumption which could be taken for granted, is a highly improbable hypothesis and the natural course of the reaction is that leading to *trans*-interchange.

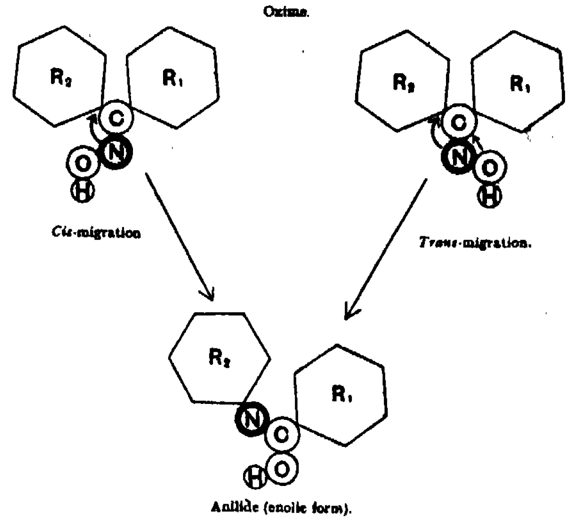


FIG. 5.

The second part of Dr. Mills's address was concerned with the problem of the optical activity of living matter. Pasteur was inclined to ascribe this to cosmical causes and later workers have invoked the influence of circularly polarised light. Dr. Mills suggested, however, that the production of dissymmetric products by living tissue is intimately connected with the characteristic property of growth which differentiates living matter from dead.

The synthesis of dissymmetric products in living tissue involves, at least in its later stages, reactions between dissymmetric substances. Such reactions are known to be stereo-specific and the velocity of the reaction is much greater with one of the optical forms than with the other. This stereospecificity is observed in comparatively simple compounds and can readily be accounted for by the shape and disposition of the parts of the molecule; in the favoured reaction the groups which react can more readily be brought into juxtaposition. With enzyme reactions a high degree of specificity is found and these reactions undoubtedly play an important part in the growth of living tissue.

From a detailed analysis of simplified models of growing tissue, Dr. Mills concludes that the optical activity of living matter is an inevitable consequence of its property of growth. Owing to the stereospecificity of the later changes, any small lack of balance between the *d* and *l* forms of the first dissymmetric product in the chain of reactions would rapidly increase and the dissymmetric tissue would grow more rapidly and soon be present in the growing organism in overwhelming amount. "The mystery of living matter seems to lie in its power of growth. Given this, the optical activity of its components appears to follow as a necessary consequence of the law of mass action and the stereospecificity of interactions between dissymmetric compounds." S. S.

Food Preservation *

RESEARCH has shown the importance of freshness in food. For an industrialised nation, living in large towns, this is not always easily ensured, even in the case of home-grown supplies, and the difficulty is greatly enhanced when the food must be transported long distances before it reaches the consumer. Refrigeration has provided an empirical solution, but our knowledge, especially on the biological side, is as yet inadequate to ensure that the subtle properties of freshness are sufficiently conserved. Research on the preservation of food is therefore of the utmost importance to the inhabitants of Great Britain; but in spite of the fact that the food imported in 1931—comprising the greater part of the wheat and fruit consumed, half the meat, poultry, eggs, and dairy produce, and a smaller proportion of the fish and vegetables—cost about one million pounds a day, the amount spent on research by the Food Investigation Board during 1931 was less than £50,000.

The necessity for economy has led to a reduction in the Board's expenditure, but the staff has not been reduced. Owing to the specialised nature of the work, losses of personnel cannot immediately be made good when circumstances warrant an expansion of the Board's activities, so that reduction of staff would delay the resumption of normal progress to an extent out of all proportion to the economy effected.

Food investigation is of value, not only to the consumer, but also to the producer both at home and in the Empire overseas. The Board has received financial assistance from the Empire Marketing Board, and co-operation with other parts of the Empire is ensured by the presence of representatives of the Dominions, India, and the Colonial Office, sitting as assessors, at the Board's meetings. The experimental work on the cold storage of food has now reached a stage when the results obtained can be transferred to the full commercial scale. The co-operative survey of the New Zealand frozen lamb industry, which was mentioned in last year's Report and full details of which are about to be published, was so successful that the Board felt that this collaboration should be continued. A Consultative Group has therefore been formed, comprising the Director of Food Investigation (Sir William B. Hardy) and members of his staff, the assessors mentioned above, and representatives of the shipping lines nominated by the Chamber of Shipping of the United Kingdom and the Liverpool Steamship Owners' Association.

The Report is this year arranged in four parts, describing respectively the researches carried out at the Low Temperature Research Station, at the Torry Research Station, and at the Ditton Laboratory, the three research stations of the Board; the fourth part deals with extramural researches carried out at the National Physical Laboratory and the Imperial College of Science and Technology. The different sections deal with meat, bacon, fish, fruit, and vegetables, as well as problems of biological engineering and canning. Each is written by the investigator who has carried out the research described, and presents the results obtained in a form which is best described as that of a detailed summary. References are given to the original papers from which fuller information may be obtained. It is not possible here to do more than refer to one or two of the more important points raised by the Report; but it is hoped to consider certain other aspects at a later date.

A preliminary survey of the problems associated with imported edible offal has been carried out by T. Moran. It was found that there is scope for improvement in grading and preparation, packing and freezing. Evaporation of water appears to be the most serious problem. These tissues are of importance for the preparation of certain medicinal products, and at present the Dominions supply only a negligible fraction of the total imported for this purpose. Prompt freezing after removal from the animal is essential, and no opportunity for thawing during storage and transport must be permitted. In New Zealand, a further difficulty has to be overcome, since the demand is almost exclusively for ox's glands at present, mainly on account of their size.

It has been shown by E. H. Callow that the transport of unsmoked mild-cured bacon from Australia and New Zealand is impracticable under existing commercial conditions, since the fat becomes rancid after less than two months' storage even if a temperature so low as $-10°$ C. is used. Gas storage may be the solution of this problem, since the rancidity is due to the fact that the fat takes up oxygen even at this low temperature. On the other hand, carcasses of frozen pork can be transported successfully and used as pork or for the manufacture of bacon. It has also been found that smoking retards the subsequent development of rancidity, whatever the temperature of storage, within the range 15° C. to $-20°$ C., but cannot prevent it entirely.

In the case of fish, it has been found that after freezing in brine, it is necessary to store at temperatures so low as $-20°$ to $-25°$ C. instead of the usual $-4°$ to $-12°$ C., if alteration in the fish is to be prevented. Fish stored at the lower temperature can be smoke-cured: hitherto one of the objections to frozen fish has been that it is quite unsuitable for smoking. The conditions required for properly smoking haddocks and herrings have been examined by A. Lumley. To give a 'finnan' finish to the former, seven hours' smoking was necessary, the temperature being gradually raised from 80° to 90° F., and the relative humidity being less than fifty per cent at 80° F. To produce a 'kipper' it was necessary to extend the time of curing to twelve hours and to raise the temperature to 95° F. for one hour and to 100° F. for the final hour. Most of the smoking in commercial practice is carried out by rule-of-thumb methods. It is suggested that the incomplete control and the length of the process

* Department of Scientific and Industrial Research. Report of the Food Investigation Board for the year 1931. Pp. x+293. (London: H.M. Stationery Office, 1932.) 5s. net.

is the reason why so many dyed kippers are on the market: dyed herrings can be smoked in 5-6 hours.

Work has been continued on the gas-storage of apples in the experimental stores at the Ditton Laboratory. At present, control over the composition of the atmosphere is obtained by regulated ventilation with fresh air, but there is now some evidence that a closer control over the percentages of oxygen and carbon dioxide in the store may be required in the case of certain varieties. Experiments have also been carried out on the gas storage of pears and bananas and the cold storage of potatoes. J. Barker has found that between $+3°$ and $-1°$ C. there is a great increase in the amount of sugar found in the potato after sixty days' storage, the concentration being inversely proportional to the temperature. The sweetening is attributed to a change in the organisation of the protoplasm. It was also found that transference from a low temperature to 15° C. for a period of only twenty-four hours completely arrested any further increase in the sugar content in the cold store.

Most fruits and vegetables undergo autolytic changes when hard frozen, even at $-20°$ C., the only exception so far observed being raspberries. On thawing such frozen raspberries, colour and flavour were perfect and the texture was scarcely altered. Blanching will permanently inhibit these changes: after blanching, peas, runner beans, and potatoes can be frozen, and on thawing again are superior to the canned vegetables. Strawberries can be frozen in syrup at $-20°$ C., and the thawed fruit is suitable for fruit salads, etc. Plums and cherries, treated similarly, turn brown on thawing; they can, however, be frozen after blanching.

Work has been continued on the corrosion of iron and tin. It has been found that ferrous salts accelerate the corrosion of tin in the presence of air by acting as carriers of oxygen. Ferric salts accelerate the corrosion of iron in the presence of air over the range of hydrogen ion concentration likely to be met with in the canning of fruit, the combined effect of air and the ferric iron being much greater than that of either of them alone, especially at a hydrogen ion concentration of about *p*H 4. Further work has also been carried out on the engineering and physical problems of the maintenance of temperature and composition of the atmosphere in stores such as ships' holds. In the storage of fruit, the metabolism of the fruit itself affects both the temperature and atmosphere of the store, and complicates the problem of maintaining a constant environment.

International Astronomical Union

THE fourth general meeting of the International Astronomical Union, attended by representatives of twenty-four countries, was held at Cambridge, Massachusetts, on Sept. 2–9, under the presidency of Sir Frank Dyson. At the opening session the Union was welcomed by the Hon. C. F. Adams, Secretary for the Navy in the United States cabinet, and by Dean Bernice Brown, head of Radcliffe College. The members of the Union were for the most part accommodated in the dormitories of the College, a very convenient arrangement giving every opportunity for the informal discussions in small groups which add so much to the real value of the meeting. The full meetings were held in the Alice Longfellow Hall of Radcliffe College, and the commissions met in the various lecture rooms. All the arrangements for the meeting were made with a thoroughness and completeness, which it would be difficult to equal, by a local committee with Prof. Harlow Shapley as chairman and Mr. L. B. Andrewes, following the late Miss Adelaide Ames, as secretary.

The formal work of the Union lay in the sessions, reports and resolutions of twenty-seven committees: these dealt with such subjects as meridian astronomy, planetary observations, *Bureau International de l'Heure*, variation of latitude, *Carte du Ciel*, stellar parallaxes, variable stars, stellar spectra —to mention only a few of them. The volume of draft reports is nearly two hundred pages long and can scarcely be summarised here, but reference may be made to the reports on solar physics, by Dr. St. John, on standard wave-lengths by Prof. A. Fowler, on stellar photometry by Dr. Seares, on radial velocities by Dr. J. S. Plaskett, and on the observations of Eros for solar parallax, by Dr. Spencer Jones.

Among resolutions passed by the General Assembly were the following: The equinox of 1900·0 was adopted for catalogues other than catalogues of precision, by agreement among the various groups of astronomers interested in the question. A proposal to fill a gap existing in astronomical bibliography between 1880 and 1899 was approved. A proposal to establish the vertical circle of the Pulkovo Observatory in as nearly equal a southern latitude as possible in the hope of improving fundamental declinations, met with much sympathy and full approval. A number of recommendations adopting fresh standard wave-lengths and urging further work on the subject was adopted. The printing of a list of designations for lunar formations was approved. Further exploration of the meteor craters in North Africa and Siberia was urged, also an extension of the meteor work now being carried on in Arizona. A resolution from the commission on radial velocities earnestly commending any project for obtaining urgently needed data in the southern sky, and welcoming the possibility of establishing a large reflector in South Africa in the event of the transfer of the Radcliffe Observatory, was passed unanimously by the General Assembly. Financial help was granted towards the printing of further volumes of the *Carte du Ciel*. Other grants were continued mostly at a reduced figure, and a new grant was made toward the reduction of the Eros observations.

On the proposal of the finance committee the unit of subscription from the adhering countries was lowered. It was hoped that this might check any further secessions of countries on financial grounds, Australia and South Africa having resigned on that score. Two new countries—India and the Vatican State—were reported as adhering since the last General Assembly, while Roumania had become a fully subscribing member of the Union. As in the number of countries adhering, so also in the numbers of commissions there were changes. The commission on dynamical astronomy was abolished at its own request, while new commissions on 'Selected Areas' and spectrophotometry were formed. The solar commission broke up once more into its earlier constituent parts in the form of commissions on sunspots, chromospheric phenomena, solar spectroscopy and radiation and eclipses.

In addition to the technical discussions and the international organisation in the commissions there was an interesting visit to the Harvard College Observatory and to its new station at Oak Ridge for a 61-inch reflector; later a demonstration was given of eclipse results so far as they could be announced. Good results may be expected apparently from chromospheric spectra obtained by the falling plate method by the Lick observers, and a very nice flash was secured by the Greenwich observers—the only British expedition in Canada which had any luck at all. Nice pictures of the corona were secured by a number of expeditions, notably the Lick party which also at last obtained some interference fringes from the coronal line. Good polarisation results are hoped for from the French and the Harvard expeditions. Amongst other interesting slides shown at the meeting were the coronal spectrograms and photographs secured by M. Lyot, of the Paris-Meudon Observatory, without the aid of an eclipse.

The next meeting of the General Assembly was fixed for 1935 (probably early July) in Paris on the invitation of the French astronomers. The newly elected executive committee to serve until then consists of Prof. F. Schlesinger (United States), *President*; Prof. T. Banachiewicz (Poland), Prof. E. Bianchi (Italy), Prof. C. Fabry (France), Prof. N. E. Norlund (Denmark), Prof. F. Nušl (Czechoslovakia), *Vice-Presidents*; Prof. F. J. M. Stratton (Great Britain), *General Secretary*.

Recent Researches on Cosmic Rays

IN the *Times* of October 8, Prof. A. Piccard gives an account of his experiments on the cosmic rays during his balloon ascent on August 10, in which he was accompanied by Max Cosyns, and reached a maximum height of 53,672 feet. Two distinct types of observations on the cosmic rays were made on this occasion, one to determine the variation of intensity of the rays with height, and the other to determine the distribution of the radiation in different directions.

The observations on the change of intensity were apparently made in the usual way by measuring the ionisation produced in a sealed vessel. Prof. Piccard states that his results over the same range of height are in good agreement with those found by Prof. Regener, of which an account was given in a letter published in NATURE of September 3. It will be recalled that in Regener's experiments, self-registering apparatus was attached to a free balloon which reached a much greater height than Piccard's balloon. He found that the intensity of the radiation increased rapidly at first with altitude, then more slowly, and finally reached what appeared to be a constant maximum at the greatest heights. The free balloon of Regener rose to a point where the barometric pressure was about 25 mm., while the lowest pressure reached by Piccard was 73 mm. The concordant results obtained by the two observers thus give us new and valuable information of the apparent variation of intensity of the rays up to the highest altitudes that are likely to be reached for some time to come.

The second type of experiment made by Piccard was to determine the direction of the cosmic rays by using a tubular Geiger counter. This device has the property of distinguishing to some extent between rays coming from different directions. At the earth's surface it can be shown with this apparatus that the rays come predominantly downwards. In striking contrast to this, Piccard finds no such directional effect at high altitudes, and thus concludes that the radiation at such great heights is uniform in all directions. He provisionally suggests that the cosmic rays have their origin in the stratosphere. He is, however, careful to point out that this is not the only possible explanation. For example, little if any directional effect would be expected if the rays were actually cosmic in origin and fell on the earth uniformly in all directions. Whatever may be the ultimate interpretation of these observations, they constitute an important contribution to our knowledge.

A vigorous attack on the problem of the nature of the cosmic rays is now being made by several new and powerful methods. The experiments of Regener and Piccard afford trustworthy information of the variation of intensity of the rays with altitude, while the work of many experimenters has given us accurate data of the absorption of the radiation for great depths of water and for other absorbing material. The earlier observations of Millikan had indicated that the intensity varied little if at all on the earth's surface. This important question has been again examined by Prof. A. H. Compton during the past year in the course of his travels in the northern and southern hemispheres. He made observations of the relative intensity of the cosmic rays by the ordinary ionisation method. He concludes that there is a marked change of intensity at different parts of the earth, especially

for the softer components of the radiation. In a recent communication to the *Physical Review* (Sept. 1, 1932) he concludes that there is a definite correlation between the intensity of the cosmic rays and the direction and magnitude of the earth's magnetic field. The intensity in general is higher the greater the angle of magnetic dip. The dependence of the intensity of the cosmic rays on magnetic latitude has also been convincingly shown by Clay and Berlage from continuous observations on a voyage from Amsterdam to Batavia.

Such a relation between intensity of the rays and the earth's magnetic field is to be expected on general grounds if the radiation consists of a stream of swift charged particles. It will be remembered that Prof. C. T. R. Wilson long ago suggested that the cosmic radiation may originate from thunderstorms in our atmosphere. In the intense electrical fields that precede a lightning flash, it is probable that electrons and other charged particles may acquire a very high velocity. If some of these pass out into space, their paths will be bent by the earth's magnetic field and a few may eventually re-enter our atmosphere. In the light of the new observations, such a possible origin of the cosmic radiations should not be overlooked. In this connexion, it should be noted that Schonland in South Africa has found that the intensity of the rays is suddenly altered by the occurrence of distant lightning flashes, but no such effect is observed immediately beneath the thundercloud.

The question of the nature of the cosmic rays is still a matter of much discussion—whether, for example, the primary radiation is of the γ-ray type or consists of a stream of fast electrons or protons—but there seems to be a growing belief that the main part of the radiation is corpuscular in character. This question is now being actively investigated by photographing the tracks of the ionising particles in an expansion chamber and observing the curvature of these tracks due to a strong magnetic field. By this method Millikan and Anderson have found that not only are swift electrons present, but also positively charged particles believed to be swift protons. Many of these particles undoubtedly have energies corresponding to several hundred million electron volts. Blackett and Occhialini (NATURE, Sept. 3, 1932) have made experiments of a similar kind using an ingenious device whereby the passage of an ionising particle through two Geiger counters in line is made to actuate an expansion chamber, placed between the counters, within a hundredth of a second of the passage of the radiation. By this device the accumulation of data should be much more rapid. By the full use of these powerful methods, we may hope soon to obtain definite information as to the nature and energy of these ionising particles, and of the effects produced by them in their passage through matter.

Reference should also be made to another strange type of occurrence observed with the cosmic rays. Hoffmann and Steinke and Schindler have observed sudden bursts of ionisation in a measuring vessel, of a magnitude far exceeding that produced by the swiftest α-particle known. It has been suggested that these bursts of ionisation arise from some type of disintegration process brought about by the cosmic rays: whatever may be the explanation, there can be no doubt these observations suggest a fascinating if difficult field for further research. It should be mentioned that Compton, in his recent experiments already referred to, noted that these bursts of ionisation are much more frequent at high altitudes, and suggested that they may be due mainly to an effect of the softer components of the radiation.

The problem of the origin and the nature and properties of the cosmic rays is one of the most interesting in the domain of physics. It is to be hoped that the concentrated attack from so many different directions will soon bring more definiteness to our knowledge of this obscure type of radiation.

Obituary

MR. WILLIAM G. COLLINGWOOD

THE death of William Gershom Collingwood, artist, archæologist and author, at the age of seventy-eight years, took place at Coniston on Oct. 1. The son of a well-known landscape painter, W. Collingwood, he was born at Liverpool on Aug. 6, 1854, and matriculated at University College, Oxford, in 1872. While at Oxford, where he took first class honours in *Literæ Humaniores*, he formed a close friendship with Ruskin, then Slade professor, and when the health of the latter broke down, accompanied him abroad to France and Italy, later settling near him at Windermere. Here he occupied himself in landscape painting, editing Ruskin's works and lecturing on the theory and history of art. After Ruskin's death he was for some time professor of art at the University of Reading.

In Cumberland Collingwood had come into contact with members of the Cumberland and Westmoreland Antiquarian Society and had been attracted to the study of Icelandic literature and the archæology of the Norse settlements in the north of England. The first fruits of his studies, however, took the form of fiction, his first novel appearing after a visit to Iceland in 1897. Ill-directed criticism of his second venture "The Bondwoman", notwithstanding its high literary merit, diverted him to a more intensive study of the Norse and Anglian archæology of northern England, especially on its artistic side, upon which he became widely recognised as the first authority. A long series of papers in the *Proceedings of the Antiquarian Society*, of which he became editor, culminated in the publication of an exhaustive and

standard work on "Northumbrian Crosses" (1927), in which a knowledge both wide and profound was combined with keen insight and artistic feeling. Although to the general public "The Life and Work of John Ruskin" among Collingwood's writings will be his strongest claim to remembrance, "Northumberland Crosses" is his most enduring achievement. Under his editorship the *Proceedings of the Cumberland and Westmoreland Antiquarian Society* attained a standard of technical and artistic excellence unusual among the publications of local scientific societies; and he was the inspiration and the organiser of much of the excellent work in archæological research which has been accomplished by the Society in the present century. In 1920 his work was recognised by election to the presidential chair.

MR. H. C. CHADWICK

WE regret to announce the death of Mr. Herbert Clifton Chadwick on Sept. 16 at the age of seventy-three years. He was the last survivor of a group of scientific men who, in the 'eighties of the last century, began the biological investigation of the Irish Sea region. For this purpose the late Sir William Herdman founded the Biological Station at Port Erin, in the Isle of Man, and Mr. H. C. Chadwick, then a business man in Manchester and an amateur naturalist, was made curator of the laboratories. He was a recognised authority on the morphology and systematics of the Echinodermata and was the author of many papers on these subjects. But his general zoological knowledge was very wide and in his capacity of curator of the Port Erin Station he was able to assist very many investigators and students who worked there during the last forty years.

WE regret to announce the following deaths:

Prof. Karl E. Ritter von Goebel, For. Mem. R.S., professor of botany in the University and Director of the Botanical Gardens, Munich, an authority on cryptogamic botany, especially Bryophyta and ferns, on October 10, aged seventy-seven years.

Dr. T. H. C. Stevenson, formerly superintendent of statistics at the General Register Office, who rendered great service in the field of vital statistics, on September 12, aged sixty-two years.

Prof. William Stirling, formerly Brackenbury professor of physiology in the University of Manchester and in 1906–9 Fullerian professor of physiology at the Royal Institution, on October 1, aged eighty-one years.

Dr. Florence A. Stoney, formerly demonstrator in anatomy at the London School of Medicine for Women, who was a pioneer in X-ray and ultra-violet light treatment, on October 7, aged sixty-two years.

Sir Everard Im Thurn, K.B.E., formerly curator of the British Guiana Museum, and in 1919–20 president of the Royal Anthropological Institute, on October 8, aged eighty years.

News and Views

Antony van Leeuwenhoek, 1632-1723

ON October 24, 1632, four days after the birth of Sir Christopher Wren at East Knoyle, Wiltshire, the tercentenary of which has just been celebrated, Antony van Leeuwenhoek, the eminent Dutch naturalist who has been called the "Father of Protozoology and Bacteriology" was born at Delft. Both Wren and Leeuwenhoek were long associated with the Royal Society in its early days, and both lived to extreme old age; Leeuwenhoek outliving Wren by six months and dying at Delft on August 26, 1723, being then aged—as his epitaph says—"90 years, 10 months, and 2 days". But the careers of these two distinguished men followed very different lines; for while Wren was first a professor of astronomy and then a great architect, Leeuwenhoek began his life as a draper and haberdasher with few advantages of education, and his fame came through his lifelong devotion to microscopical studies. The son of a basket maker, he was sent to a school at Warmond, near Leyden, and at sixteen was an apprentice in Amsterdam. At the age of twenty-two years he married and set up in business for himself in his native town, and for thirty-nine years was "Chamberlain of the Council-Chamber of the Worshipful Sheriffs of Delft". He was also a surveyor and wine gauger. When he began his work with his simple microscopes is not known, but at the age of forty-one years he addressed the first of his many letters to the Royal Society, then eager to get into touch with all men working for "the promotion of natural knowledge", and it was through these letters he became famous. He was made a fellow of the Royal Society in 1679 (1680 N.S.), a *correspondant* of the Paris Academy of Sciences in 1699, and in 1716 the University of Louvain presented him with a medal. At his death at Delft in 1723 he was buried in the Old Church, in which his daughter Maria, in 1739, erected a monument to his memory.

Leeuwenhoek and the Royal Society

THE connexion of Leeuwenhoek with the Royal Society was unique, since, although for fifty years he was a constant correspondent and for forty-three years a fellow, he never attended a single meeting. His letters were all written in old-fashioned Dutch and before publication in the *Transactions* were translated into English or Latin. They were none the less highly appreciated and many distinguished men visited Delft in order to see the writer of them. He, indeed, became one of the 'sights' of the pleasant town. In spite of his wonderful discoveries and his communications to the Royal Society, hitherto there has been no good account of his career in English.

But the three-hundredth anniversary of his birth is happily marked by the publication by Prof. Clifford Dobell of a handsome volume entitled "Antony van Leeuwenhoek and his 'Little Animals' being some Account of the Father of Protozoology and Bacteriology and his Multifarious Discoveries in these Disciplines". Prof. Dobell has been called Leeuwenhoek's "greatest living admirer" and his book is worthy of his hero. How he was led to the study of Leeuwenhoek's letters in the original Dutch, what difficulties he met with and how these were gradually overcome are set forth in an entertaining prefatory epistle, while after this come chapters dealing with the life of Leeuwenhoek, his observations on protozoa and bacteria, his microscopes and methods of work, his language, his writings and other matters. Leeuwenhoek appears to have been singularly free from prejudice and in one of his letters wrote: "As I aim at nothing but Truth, and so far as in me lieth, to point out Mistakes that may have crept into certain Matters; I hope that in so doing those I chance to censure will not take it ill; and if they would expose any Errors in my own Discoveries, I'd esteem it a Service; all the more, because 'twould thereby give me Encouragement towards Attaining of a nicer Accuracy."

Australian National Research Council

At the annual meeting of the Australian National Research Council held in Sydney in August, it was determined to make a special effort to secure further financial support for the chair of anthropology which was established in the University of Sydney some time ago through the activity of the Council. The existence of the chair is threatened by recent reductions in government grants. In recognition of the work of its first two presidents, Sir T. W. Edgeworth David and Sir David Orme Masson, the Council has established two lectureships to be awarded alternately at two year intervals, the David lectureship, commencing in 1933, to be devoted to geology or biology, the Masson lectureship, commencing in 1935, to physics or chemistry. A bronze medal in honour of Sir Thomas Ranken Lyle, the retiring president, is to be struck and it will be awarded not more frequently than every second year to such Australian worker in mathematics and physics as may appear to the Council to be worthy of the honour. The incoming officers are: *President*, Sir George A. Julius; *Vice-Presidents*, Sir William Mitchell, Dr. A. C. D. Rivett, Prof. N. T. M. Wilsmore, Prof. H. C. Richards; *Secretary*, Mr. A. J. Gibson; *Treasurer*, Dr. H. G. Chapman; *Executive Committee*, Sir Douglas Mawson, Profs. Agar, Watt, Osborn and Goddard, Drs. Waterhouse and Dickson, and Messrs. Andrews, Gepp and Wainwright.

A long discussion as to the future policy of the Australian National Research Council and its relationship to the International Research Council took place at the annual meeting. The standing of the Council as a national academy of sciences for the Commonwealth was reaffirmed and, with the object of stimulating its working in certain respects, the executive committee was requested to introduce such changes in constitution and by-laws as might be necessary to give effect to the following objects:—(1) the institution of a very limited fellowship; (2) the appointment of distinguished overseas scientific workers who have been associated with science in Australia as honorary overseas fellows; (3) migration of headquarters between capital cities; (4) alteration in rules of appointment to the executive committee to ensure more frequent changes in personnel and to effect closer contact with Royal Societies and other scientific bodies; (5) the display of greater initiative and leadership in the attack upon major problems associated with science in Australia, the Mandated Territories and the Australian quadrant of the antarctic continent; (6) the devising of practical means for bringing members in all centres into more intimate touch with the handling of these problems; and (7) the formation of a committee to explore the possibilities of a federation of Royal Societies and certain other scientific organisations in Australia.

Exhibition of Inventions

The eighth International Exhibition of Inventions organised by the Institute of Patentees (Incorporated) was opened at the Central Hall, Westminster, on October 5 by Sir Maurice Jenks, the Lord Mayor of London. The opening was followed by a luncheon at St. Ermin's Restaurant, when Lord Askwith, president of the Institute, remarked that it is not the old men, but the young, who are bringing marvellous things into the world. As in former years, the exhibition is divided into two main sections, a trade section which includes many things already on the market, and a section of new inventions, the latter being sub-divided into groups of exhibits relating to domestic and labour-saving appliances, electrical and radio apparatus, building and housing details and mechanical apparatus. As might be expected, the last of these groups contains many new devices for motor vehicles such as brakes, lights, signalling signs and means for preventing cars being stolen. One interesting exhibit is a small electrically driven model boat in a tank for demonstrating the increase in efficiency of the propeller obtained by surrounding it with a ring of approximately cone section. Other exhibits relate to internal combustion engines and to variable speed gear and transmission gear.

A Reversing Centrifugal Gear

Among the last group of exhibits in the Inventions Exhibition is the new epicyclic gearing invented by Prof. F. Soddy, the main object of which is to provide for the transmission of large powers at high speed, and for reversing without declutching. The gear in one form or another is therefore suitable for use with steam turbines or high-speed marine engines. Unlike most epicyclic gears, there are in it no toothed wheels. The driving and driven shafts are co-axial. On the end of the driving shaft are

two cranks at 180° apart and these drive two heavy 'planets', which have a slight freedom of movement in a radial direction relative to the crank pins. When the shaft is revolved at high speed, the planets are thrown outwards by centrifugal force and their outer surfaces come into contact with the inner surface of a fixed annular casing around which they begin to roll. The disc of each planet is pierced with circular holes and in these fit loosely a corresponding number of rollers and studs carried by discs on the driven shaft. It is through these that the power is transmitted. The gear can be arranged so that if necessary the second shaft is fixed while the casing revolves, while by using planets of a different design the gear can be made reversible. The exhibit attracted considerable attention and it is to be hoped will soon be tried on a large scale.

A Dinosaur from Montana

During the past summer, a party from the American Museum of Natural History, under the leadership of Mr. Barnum Brown, has explored the Cretaceous rocks of Montana in which remains of fossil reptiles occur. According to a message from the New York correspondent of the *Times* which appears in the issue of Oct. 1, it has found a nearly complete skeleton of the armadillo-shaped dinosaur *Nodosaurus*, which has hitherto been known only from fragments. The reptile is remarkably broad, for although it is only 14 ft. long, it is 7 ft. wide at the hips. It is heavily armoured with bony plates, which are arranged to give flexibility to the trunk and tail. It has feeble teeth adapted for feeding on either vegetables or insects. *Nodosaurus* was first recognised and named in 1889 by the late Prof. O. C. Marsh, who received characteristic pieces of it from his collectors in the Cretaceous rocks of Wyoming. A somewhat similar fossil skeleton, without head, was discovered in 1913 by the late Mr. W. E. Cutler in corresponding deposits in Alberta, Canada, and it is now exhibited in the British Museum (Natural History). It was named *Scolosaurus cutleri* by Baron Nopcsa, who published a restored drawing of it by Miss Alice B. Woodward in the *Illustrated London News* of Sept. 11, 1926. *Scolosaurus* must have been about 12 ft. long, and would be only about 3 ft. high when walking. A smaller reptile of the same group was found long ago by the late Rev. William Fox in the Wealden formation in the cliffs on the south coast of the Isle of Wight, but he was able to recover it only in a rather fragmentary state. It was named *Polacanthus foxi* by Hulke, and is now also exhibited in the British Museum (Natural History).

Memorial to the Late Sir Andrew Balfour

On October 6 the Earl of Athlone, Chancellor of the University of London, unveiled a memorial tablet to the late Sir Andrew Balfour, first director of the London School of Hygiene and Tropical Medicine, in the entrance hall of the School. The tablet, which is of polished Roman stone with a bas-relief head in bronze, is the visible part of a twofold memorial, the other purpose being a scheme to enable students, preferably those from overseas, to pursue courses of study at the School. At the ceremony the Chancellor paid a well-deserved tribute to Sir Andrew and his world-wide work in the cause of tropical medicine and public health. Referring to the organisation of the London School of Hygiene and Tropical Medicine he said: "To that work which was, alas, to prove the last of his labours—the building, the equipment, the organisation of this great School—Andrew Balfour brought the same passionate zeal, the same untiring energy which were characteristic of his whole career, and his inspiring personality is so very fresh in the minds of all of you that of his last great piece of work there is hardly any need to speak. The appointment of Andrew Balfour to be the first Director of this School gave to the School from its very inception a splendid introduction throughout the whole world and contributed perhaps more than anything else to the reputation which it has already established. Finally, and in a word, Balfour was a great Empire builder; and when I say this I am thinking not so much of his devotion to work, of his vast knowledge and contributions to the subject of Empire health, not of his academic distinctions, not of his contributions to sport and literature, but of his fine character. He was without guile, honest to the core, a man who evoked in his colleagues a spirit of love and sacrifice." It is fitting that the memorial tablet bears the quotation from Walt Whitman which Balfour himself loved:

> "Through the battle, through defeat, moving
> yet and never stopping,
> Pioneers! O pioneers!"

Excavations in Westmeath, Ireland

Exceptional interest is attached to the finds which have been made by the Harvard University Archæological Expedition in excavating a crannog at Ballinderry, near Moate, Co. Westmeath, Ireland, and an early bronze age cairn at Knockast nearby. The excavations are in charge of Dr. H. O'Neill Hencken, whose recent book on Cornwall in the "County Archæologies" series, has given him an assured place among authorities on British archæology. The crannog was first identified by Dr. Adolf Mahr, of the National Museum of Ireland, some four years ago, when a Viking sword was found in the course of cutting a drain across the bog. The island constituting the crannog is built up of layers of brushwood and peat contained by timber piles, on which lay a substructure of massive timbers supporting further layers of peat and brushwood and the floor of a circular dwelling. Above this, and built some time later, were two smaller rectangular houses. Judging from the animal remains, the inhabitants were both hunters and herdsmen, while the coulter of a plough and querns indicate their practice of agriculture. In place of pottery they used well-turned wooden vessels, made on a lathe, and barrels made of staves and hoops. Among the tools and weapons of iron was a Viking battle-axe. The remains are dated at about A.D. 1000. The

most remarkable finds were a hanging lamp and a gaming board. The former is described by a correspondent of the *Times*, who gives an account of the discovery in the issue of Oct. 7, as "the finest bronze which has yet come to light in excavation in Ireland". It is a pointed oval, with three hanging chains attached to animal heads, and is decorated with rosettes and an acanthus scroll. It will be interesting to hear Mr. Kendrick's analysis of its relation to the British hanging bowls, from which descent is claimed for it. The wooden gaming board has forty-nine holes and is bordered with carved Celtic patterns, said to be the finest Viking object known from Ireland.

Television Broadcasting

THE transmissions from Broadcasting House, London, of television by the Baird process have fulfilled the expectations of the radio engineers. Some think that this may lead to the revival of the 'puppet' show which was very popular about two hundred years ago. The London transmissions have been seen well in Scotland, a distance of more than 400 miles. At present two bands of radio frequencies are required in the overcrowded ether, one for the visual and another for the sound signals. In *Television* for September A. P. Peck describes a new system of broadcasting developed by the Columbia Broadcasting Company of New York which uses only one wave for both sight and sound signals and thus makes a smaller demand on the available channels in the ether. A low-powered 45 kc. (kilocycle) oscillator is used in the first instance for the sound signals, the wave being modulated by the sound programme coming from the television studio. The sound modulated current includes frequencies up to 5 kc. on each side of the carrier wave. The wave with the television signals occupies the band on the frequency spectrum ranging from 2750 to 2850 kc. The sound signal is actually radiated on two sub-carrier waves with frequencies of 2755 and 2845 respectively. With this arrangement the Columbia engineers have got satisfactory results. Not only does the method save space in the ether but it also saves equipment at each end. It is a great advantage to the average 'looker in' to have a receiver for both sight and sound which is compact, not easily damaged and simple to operate.

Revised Standard Frequency Radio Transmissions

THE modern extensive use of radio communication of all types demands for its success that each transmitting station shall keep very exactly to its allotted wave-length or frequency, so that interference with transmissions on neighbouring wave-lengths may be reduced to a minimum. At the present time the majority of commercial radio transmitting stations on land, including those employed for broadcasting purposes, use in their installation a source of oscillations the frequency of which is accurately controlled by means of a tuning fork or piezo-electric crystal. In order that the administrations to which these stations belong may be able to measure and adjust their wave-lengths very accurately, it is necessary that their controlling apparatus may be frequently checked against some national or international standard. It was to meet this need that on behalf of the Radio Research Board of the Department of Scientific and Industrial Research, waves of accurately known frequency have been transmitted for some years past from the wireless station at the National Physical Laboratory for checking the calibration of wavemeters and other apparatus.

THE programme of transmissions has recently been revised and the main standard now employed consists of a single frequency of 1,000 cycles a second. This frequency is derived from an installation which is maintained in continuous operation, day and night, at the National Physical Laboratory and serves as the national standard of Great Britain. This low frequency standard is emitted in the form of a modulation on a carrier wave the nominal frequency of which is 360 kc./s. (wave-length 830 m.). A regular monthly programme of such transmissions is now maintained by the National Physical Laboratory to enable all those desirous of doing so, to receive the transmission and to make a comparison between their own frequency standard and that of the Laboratory. In addition, a second quarterly programme of standard frequency transmissions consisting of a controlled carrier wave of frequency 1785 kc./s., is still maintained by the Laboratory, largely for the benefit of amateur experimenters. Those interested in this work can obtain a copy of the programmes of transmissions on application to the Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, London, S.W 1.

Pharmacy and Recent Advances in Science

THE opportunities which the present rapid advances in science offer to the student formed the text of the address delivered by Dr. C. W. Kimmins at the opening of the School of Pharmacy of the Pharmaceutical Society of Great Britain on Oct. 5. For the scientific research worker there are all sorts of important problems awaiting solution. A student of organic chemistry frequently encounters puzzles such as this: a substance is known as a natural product of great medicinal value; the chemist works upon it and finds that a substance can be produced synthetically apparently exactly similar, yet the physiological properties may differ in a marked degree. Many of these problems of the different action of synthetic and natural substances have been solved, but delightful fields for research remain. Even in a limited field, to have extended the bounds of human knowledge must ever be a source of intense gratification to the worker. To take another example, in physical analysis, scientific workers at one time concentrated exclusively on the elements of the visual spectrum; but of late years a great transformation has taken place. Men of science are concentrating on the larger wave-lengths on one side and the smaller wave-lengths on the other, with the relative neglect of the intermediate wave-lengths. When the ultra-violet part is successfully

charted and carefully studied it will cast a wonderful flood of light on physiological processes, especially upon the growth of plants, so many of which are materially affected by stimuli associated with minute wave-lengths. With such advances in science and the solution of previously apparently insolvable problems, it is not to be wondered that the enthusiastic student of to-day has developed a spirit of adventure unknown in former days.

The Giant Horntail Borer

A short time ago a cinema picture of the giant horntail borer (*Sirex noctilio*) and its parasite (*Rhyssa persuasoria*) was shown in the theatres of New Zealand. This picture was of especial interest to the Dominion, since it was upon the researches into the biology of these insects in England on behalf of the Cawthron Institute, Nelson, that the picture was based. Owing to the widespread establishment of *Sirex* in the exotic coniferous forests, particularly of *Pinus radiata*, in New Zealand, Sir Guy Marshall, of the Imperial Institute of Entomology, was approached by Dr. D. Miller, and as a result, the former arranged with Dr. Thomspon, of the Empire Marketing Board's Parasite Laboratory at Farnham Royal, for a study to be made of the parasite *Rhyssa* in order that supplies might be secured and sent to New Zealand. This has been done and the parasite liberated in its new environment. The actual life-history studies on *Rhyssa* were undertaken by Dr. Chrystal, of the School of Forestry at Oxford, where the picture was made. It is work of this nature, especially when presented to the public in picture form, that forcibly demonstrates how dependent the overseas Empire States are upon the assistance of such institutions as the Imperial Institute of Entomology and the Farnham Royal Parasite Laboratory.

Antiquities from the Thames

A question of considerable interest to archæologists was raised at a meeting of the Thames Conservancy Board on October 10 in connexion with a report by Prof. Elliot Smith on a human skull and bones of late bronze age which had been dredged from the bed of the Thames below Hampton Court Bridge. A letter was presented from the Council of the London and Middlesex Archæological Society asking that articles of archæological interest from the bed of the Thames should be deposited with the museums of the county in which they were found, and suggesting that objects found in Middlesex should be deposited at the Brentford Museum. The decision of the Board was to refuse the request on the ground that it was felt that all relics from the Thames should be together in the possession of the Board. The opinion of a majority of archæologists would probably be in favour of the claims of local museums in this matter; but there is much to be said for the single collection, in view of the character of the Thames as a highway of culture from very early times. This argument, however, loses force when it is remembered how many antiquities from the Thames already lie scattered in various museums and collections. The most cogent consideration is the accessibility of the material for purposes of study. Apart from the suggestion of loans to museums from time to time, Lord Desborough, as chairman, could only hold out the vague hope that the Conservancy might be able to display its collections at some indefinite future time when space might become available. It is very desirable that the collection now in the possession of the Thames Conservancy should be accessible to students. A statement from the Board as to how far this is possible, and if at all, in what conditions and under what regulations, would be welcome.

Industrial Organisation

Arrangements have been made by the Governing Body of the Imperial College of Science and Technology for the delivery during the present session of a series of special lectures on various of the productive industries by lecturers whose experience will enable them to speak with authority. The lectures will be given in the Huxley Building of the Royal College of Science, Exhibition Road, S.W.7 on certain Thursdays at 4 p.m., and will be open to all members of the College staff and students. The lectures during the autumn term will be by Dr. Herbert Levinstein, on the chemical manufacturing industry (Oct. 27); Mr. Austin Hopkinson, on the advantages of the small industrial organisation (Nov. 17); Mr. Maurice Solomon, on the electrical industry with special reference to the advantages of the large industrial organisation (Dec. 1); and Mr. G. M. Burt on the building industry (Dec. 15). Particulars of the lectures during the spring term will be announced later; but they are expected to treat of (*a*) the heavy engineering industry, (*b*) the textile industry, and (*c*) the steel industry. It is intended to publish the seven lectures in a volume.

The immediate object of the lectures is to give Imperial College students, many of whom enter manufacturing industries after graduation, an idea of some of the bigger problems, of whatever nature, which confront manufacturers at present, and to suggest what the future may have in store, either in the way of technical improvements, or as a result of national and international developments. In taking this step the Governing Body has been prompted by the feeling that, in this time of world depression, the considered views of the manufacturer have not been sufficiently heard. The lecturers have accordingly been chosen from distinguished men in control of particular branches of the productive industries, and able therefore to speak with authority upon the subjects with which they will deal.

Training in Industrial Management

The increasing complexity of industrial management, together with the intensification of world competition, seems to call for the more effective training of managers and industrial executives than has been usual in the past. To meet the special requirements of 'industrial scientists', a course of training in industrial management is to be started by Mr. W. R. Dunlop at 57 Gordon Square, London. The aim is to supplement the basic scientific training

of the physicist, chemist, biologist or engineer with a training in the methods, functions and problems of industrial and business management. The course extends over a period of three months and covers "The Function and Problems of Industrial Management", "Sciences underlying Industrial Management" and "The Mental Activity of Industrial Management."

"Current Science"

WE have often commented on the increased interest which is being shown in science in India and further evidence of this is afforded by the issue of a new scientific monthly, *Current Science*, the first two parts of which have now been received. The journal, which is published at the Indian Institute of Science, Bangalore, under the direction of a strong editorial board, is modelled on NATURE both in its format and in the arrangement of its contents. The first two numbers contain editorials on "Retrenchment and Education" and "Unemployment among the Educated Classes". The former is of general interest, the latter, however, deals with a problem peculiar to India and one which has arisen mainly from the adoption of a university degree as a means of entry to Government service. The problem is now acute and without doubt steps will have to be taken to raise the degree standard in Indian universities and simultaneously to institute Civil Service examinations. Other articles of interest are "The Study of Nutrition in India" by Col. R. McCarrison and "Chemistry and Currency" by Dr. Gilbert J. Fowler. Numerous short scientific communications appear in the form of letters to the editor and there are short abstracts of recent publications in other journals. We welcome the appearance of this new monthly; if the standard of the first two issues is maintained it will be a valuable addition to scientific literature.

Automatic Temperature Control

WHEN the temperature during an industrial process must be kept constant it is more economical to do it automatically than by hand, and in a thirty-page pamphlet issued by Messrs. Negretti and Zambra methods of control are described. They depend on mercury in steel thermometers in which the capillary tube ends in a Bourdon tube which uncoils as the temperature of the bulb of the thermometer rises. This actuates a mercury switch if the heat supply to the furnace or chamber is electrical, or a compressed valve in a two-atmosphere air supply leak if the heat supply is gas or liquid. The change of pressure of the air supply operates a valve in the gas or liquid supply pipe.

Announcements

THE Secretary of State for the Colonies has appointed Mr. P. C. Chambers to be agricultural officer, Kenya.

THE Thomas Hawksley Lecture of the Institution of Mechanical Engineers will be delivered by the Right Hon. Lord Rutherford on Nov. 4, at 6 P.M. Lord Rutherford has chosen as his subject "Atomic Projectiles and their Applications".

MR. H. J. PAGE has been appointed controller of the Agricultural Research Station of Imperial Chemical Industries, Ltd., at Jealott's Hill, Bracknell, Berks, following the release of Sir Frederick Keeble from his executive and routine duties at that Research Station. Mr. Page was until 1927 head of the Chemical Department and chief chemist at the Rothamsted Experimental Station, and since that time has held the position of head of the Research Laboratories and chief chemist at the Research Station of which he has now taken charge.

AT the annual meeting of the Yorkshire Naturalists' Union to be held on Dec. 10, it is proposed to present to Mr. Thomas Sheppard, director of the Hull Municipal Museums and editor of the *Naturalist*, the official organ of the Union, his portrait in oils by Mr. Vincent Galloway. The presentation is to mark the retirement of Mr. Sheppard from the editorship of the *Naturalist* and as an appreciation of his work in that capacity for the last thirty years. Subscriptions may be sent to the Hon. Treasurer, The Yorkshire Naturalists' Union, Sackville Street, Leeds.

AN award of the Harrison Prize will be made next December by a committee consisting of the presidents of the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry and the Pharmaceutical Society. The Prize is of the value of about £150 and is awarded to the chemist who, in the opinion of the Selection Committee, during the last five years has conducted the most meritorious original investigations in any branch of pure and applied chemistry and has published his results. Further information can be obtained from the President, The Chemical Society, Burlington House, Piccadilly, London, W.1.

A MOVEMENT is on foot among the engineering profession to mark in an appropriate manner the centenary, in April next year, of the death of Richard Trevithick, one of the greatest of British engineers. A meeting of representatives of engineering institutions will be held on October 20, at 5.30 P.M. at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1. Engineers generally who are interested in the proposal are cordially invited to attend. The movement was started by the Newcomen Society for the Study of the History of Engineering and Technology, the honorary secretary of which is Mr. H. W. Dickinson, Barn Field, Riddlesdown Road, Purley, who will be pleased to answer inquiries.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in biology at the Bishop Otter College (Church of England) for Women Teachers, Chichester —The Principal (Oct. 24). A director (professor) of the Research Laboratory in Zoology and a director (professor) of the Research Laboratory in Biochemistry at the University of Madras.—The Registrar, University of Madras, Triplicane, P.O., Madras (Dec. 1).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Oldoway Human Skeleton

IN NATURE of June 18, 1932, page 903, Prof. D. M. S. Watson and C. Forster Cooper discuss further the question of the Oldoway human skeleton. I should be grateful for space to reply to certain points raised by them.

They state: "Dr. Leakey now claims that the skeleton was buried in Bed 2 before Bed 3 was deposited over it. This involves the supposition that the deposition of the materials of Bed 2 took place in water so shallow that a bedding plane was at one time exposed to air and sufficiently dried to allow men to walk over it and dig a grave in it." I simply cannot agree that any such supposition is necessarily involved. Bed 2 *is* a shallow water deposit and its surface may have dried up as they suggest; but there is another explanation equally possible: that the body of Oldoway man was deposited into the deposits of Bed 2 *under water*. Even to-day in certain circumstances, some native tribes dispose of the bodies of undesirables, such as suicides, in just such a way, "so as to prevent the spirit from escaping". Possibly the idea of a burial under water had not occurred to my critics.

Concerning the rate of erosion, my own estimate is that at a time less than fifty years before Prof. Reck came to Oldoway, the site where he found the skeleton was covered by a deposit consisting of a very small relic of Bed 3 overlain by Bed 5 and the steppe lime. The rate of erosion can be estimated fairly accurately from certain facts, and if anything, I believe my estimate is on the conservative side. Moreover, I do not remember ever having mentioned "survey pegs inserted by Prof. Reck in 1913"; for they do not exist. What we did find were the stumps of the corner posts of the hut erected by Prof. Reck over the skeleton while he was working on it. Experiment shows that these posts, if they were to hold the weight of the hut, must have been inserted at least eight inches into the ground, and the hut was erected on the flat. When we found them, erosion *on the flat* had been such that one of the post stumps had fallen and the others were sticking a bare two inches into the ground. In other words, erosion on the flat had been about six inches between 1913 and 1931.

Actually, of course, erosion does not go on at a constant rate, but the cliff face has receded between 1 ft. 6 in. and 2 ft. since Reck was there in 1913. If Prof. Watson and Mr. Forster Cooper had seen the site, I cannot believe that they would still contend that the skeleton represents a relatively recent burial.

I agree that the mere fact that the bones of the Oldoway skeleton are as much mineralised as others from Bed 2 (though less so than bones from Beds 3 and 4) is of itself evidence of no great value, but I would like to point out that Messrs. Mollison and Giesler, after a very careful study of the amount of organic matter remaining in the bones, formed the conclusion that the skeleton was not younger than Magdalenian. I would further point out that, so far as I understand them, Messrs. Mollison and Giesler do not dwell on the resemblances to the Masai. Their argument is rather that "as we find certain Oldoway characters among Hamites it is quite possible that these characters are of old standing in Africa and form one element (perhaps mixed with negro) among the Hamites". This is very different from a statement that Oldoway man resembles the Masai who still inhabit the district.

My criticisms and replies to other points raised in the letter must be reserved for our detailed report. I must, however, add that I do regard the discovery of the Kanam mandible and the Kanjira skulls as relevant to the Oldoway problem, in that they at least show that *Homo sapiens* was in existence at the time when Bed 2 at Oldoway was being formed.

L. S. B. LEAKEY.

(Written in camp at Oldoway. Aug. 14, 1932.)
P.O. Box 40,
Limuru,
Kenya Colony.

HAVING recently visited Oldoway, and having studied the geological sections there displayed, especially with the view of evaluating evidence for or against the Bed 2 age of Oldoway man, I am deeply interested in Prof. Boswell's letter in NATURE of Aug. 13, under the above title, and I should like to offer the following remarks.

Average samples of the beds were taken and these were studied in the laboratory by Mr. W. C. Simmons, senior assistant geologist on my staff, who has considerable experience of such work, and from my own investigations and the work of Mr. Simmons I personally have no objection to the post-Bed 4 age of the human remains. Indeed, field studies have inclined me to the view that Oldoway man is probably of Kenya Aurignacean date, and from personal knowledge of the site I am persuaded that he is pre-steppe limestone. Prof. Boswell and Dr. Solomon have, I consider, shown the human fossil to be younger than Bed 4, but I contend they have not done more than that; at any rate, it would so appear from the former's letter. The fact that the matrix from between the ribs contains bits of concretionary limestone containing a mineral characteristic of Bed 4 does not prove the burial to be post-Bed 5, for Bed 4 contains concretionary limestone, and for that matter so do the other beds, not excluding Bed 2, a fact to which I particularly directed Dr. Leakey's attention.

E. J. WAYLAND.

In Camp,
Nsongezi,
Kagera River, Uganda.
Sept. 17.

Lubricating Oils and Cancer

IN connexion with a recent note on emulsification,[1] Mr. W. T. Astbury has directed our attention to the latest report of the Manchester Committee on Cancer. According to the *Times* abstract from this report, "the addition of a small quantity of saponifiable oil to the lubricating oil reduces markedly the number of tumours induced. No oil surpasses lanolin in this respect. The substitution of lanolin for castor oil as a protection for oil workers has markedly lessened dermatitis among them, particularly if the workers

are young". A striking parallel exists between these results and the data obtained for the removal of mixed oils from wool. It has been shown that mineral oil is extremely difficult to remove from wool by emulsification, owing to high oil-water interfacial tension and high adhesion. The difficulty can be overcome by the addition to mineral oil of polar compounds which reduce the oil-water interfacial tension without increasing adhesion so far as to make emulsification difficult. Fatty acids, and glycerides such as olive oil, were found to be ineffective compared with oleyl alcohol, which causes ready emulsification in 6 per cent concentration. Similarly, certain alcohols from lanolin may be used to confer emulsifiability on mineral oil, a mixture containing 15 per cent being emulsified with as much ease as olive oil.

The parallel between these two sets of results suggests that the incidence of dermatitis and tumours may be caused by the difficulty of removing mineral oil from skin by means of soap solution, and that lanolin is effective only in so far as it affects emulsifiability. Working on this hypothesis, Prof. R. D. Passey, director of cancer research of this University, has commenced experiments with mixtures of mineral oil and polar compounds possessing the necessary critical oil-water interfacial tensions. The inherent probability of the view that ease of removal of mineral oil from skin must lessen the risk of cancer formation, impels us to say that, on the basis of the work on emulsification, mixtures of mineral oil and derivatives of wool fat were prepared for use on textile machinery, but simply on account of their improved lubricating properties and ready emulsifiability. The possibility of such mixtures being non-carcinogenic was in no way foreseen.

J. B. SPEAKMAN.
N. H. CHAMBERLAIN.
Textile Chemistry Laboratory,
The University, Leeds.
Sept. 16.

[1] Speakman and Chamberlain, NATURE, 130, 274; 1932.

Inheritance of Acquired Characters

THE interesting letter from A. F. Dufton in NATURE of Oct. 1, p. 508, suggests a statistical method of study of the possible transmission to the offspring of mental characteristics acquired during their life by their parents, the possibilities and limitations of which seem to have been little explored or discussed. Mr. Dufton takes the age distribution of the fathers at the birth of 1000 eminent persons from the fourteenth edition of the "Encyclopædia Britannica", and shows that these ages are distinctly higher than the ages of the fathers of 100,000 children less than one year of age at the Census of Scotland in 1921. At first sight the inference might be drawn from this fact that the superior ability of the children was due to the increased wisdom acquired by their parents during their experience of life; but, before drawing this conclusion, there are one or two preliminary points to be considered.

(1) It is certain that during the relevant period the upper and middle classes married on the average some few years later than the general population. Presumably, the ages of fatherhood in these classes were also somewhat retarded. If, as one might suppose, the 1000 eminent persons chosen by Mr. Dufton came disproportionately from these classes, this alone would explain the greater age of paternity. A more satisfactory comparison would be between the ages of paternity for the eminent persons, and those of their less eminent brothers and sisters. This reduces itself to a comparison between eminent and non-eminent persons from the same families according to order of birth.

(2) In comparisons between selected and unselected children according to order of birth, great care is unfortunately necessary to eliminate the effects of death in childhood. It is a mistake to assume, for example, that corresponding to every sixth child, there is one child of each preceding birth order, who might equally have become eminent. In families of six or more, some of the first five children will have died before attaining an age at which their talents might have raised them to eminence. Again, among families terminated voluntarily, the sex ratio of the last child must be much disturbed in favour of males, and more than half of the 1000 eminent persons are doubtless of this sex. A just comparison will require the proportion of eminent to all the surviving non-eminent, according to birth rank and size of family, for the two sexes separately. Such a tabulation would be full of interest.

(3) Supposing the sociological and statistical difficulties of the comparison were overcome, it would be a matter for further inquiry whether the differences observed (supposing them to be in the same direction as those found by Mr. Dufton) were due to the inheritance of environmental modifications, or to environmental modifications themselves. There is little doubt that children brought up in close contact with others slightly older than themselves are somewhat more precocious (in reading and writing for example, and in acquiring a vocabulary) than others without this advantage. Again, if parents increase in wisdom with years, should not this wisdom be partly applied in improving the upbringing of the later children? I mention these points, not to discourage inquiry into the effects of birth rank, but to show that the specific question of a Lamarckian factor is not more easily disentangled in this than in other modes of inquiry.

(4) Some doubt might be felt whether all forms of capacity do increase greatly with increasing age, say from 30 to 43, to take the quartiles of Mr. Dufton's distribution for the fathers of the eminent. Should we not expect that the fathers of athletes, aeronauts and possibly artists and poets, and any occupations showing enterprise, receptivity and a capacity to learn, should be younger than the average, while those of misers and politicians should be conspicuously older? Opinions will doubtless differ widely as to the position of men of science.

R. A. FISHER.
Rothamsted Experimental Station,
Harpenden, Herts.
Oct. 3.

Diamagnetism of Molecules

FOR diatomic homopolar molecules the bond-forming electrons are imagined to be concentrated within the region of the two nuclei and to experience the attractions of the different centres. The resulting torque causes a continual transference of angular momentum between the electron and the nuclei, and, as has been shown by Van Vleck, the average square of the electronic angular momentum, and

hence of the magnetic moment, does not vanish even for ^1S state of the molecule. This causes a loss in diamagnetism the magnitude of which is proportional to the degree of concentration of charge within the region between the nuclei; this concentration is also responsible for the more essential part of the binding energy of a homopolar molecule. Hence for diatomic homopolar molecules we should expect that the loss in diamagnetism on molecule formation will be proportional to the binding energy.

The table given below attempts to test this conclusion. The atomic χ values have been computed by Slater's method. As these values are for isolated atoms, comparison would have been justified if the molecular χ's referred to the gases. Unfortunately, observations are available mostly for solids and liquids. There is also an uncertainty in the spectroscopic determination of the dissociation energy. Considering all those factors, it would seem from a study of the table that the relation holds to a first approximation.

Table I.

	Calc. (atom + atom)	Obs. (molecule)	Percentage loss	Dissociation energy (spectroscopic)	Dissociation energy (thermal)
H_2	4·86	3·99	18	4·42	4·2
C_2	18·82	11·70 (diamond)	37·5	7·0	
N_2	16·20	11·8	27	9·0*	
CN	17·51	11·25	36	9·5	
S_2	44·02	30·72 (rhombic sulphur)	30	4·9	
Cl_2	40·78	40·47	1	2·54	2.47
Br_2	67·56	62·4	7·7	1·96	2·0
I_2	102·86	91·5	11	1·53	1·6

The susceptibility and energy data are taken from the International Critical Tables except * which is from NATURE, vol. 129, 870; 1932). It appears roughly that there is a loss of about four per cent per volt of dissociation energy. Cl_2 does not fall into the scheme. There are reasons for believing that the computed value for I_2 is too high, which if true will improve the agreement. A detailed paper appears elsewhere.

D. P. RAY-CHANDHURI.
University College of Science,
Calcutta. Aug. 18.

Nuclear Structure

IN a recent note in NATURE,[1] Bartlett has shown that the nuclei of the light elements may be represented by a model built up of appropriate numbers of neutrons and protons arranged in independent groups about an α-particle. It seems very significant that the numbers of protons and neutrons thus assigned to the p- and d-shells are the same as those required by the Pauli Exclusion Principle for electrons. This at once suggests that quantised spins and orbital momenta are also associated with the neutrons and protons in the nucleus. From quite another point of view, Heisenberg[2] has found it necessary to assign a spin, $\frac{1}{2}\cdot\frac{h}{2\pi}$, to the neutron.

Considerable support can be found for such an extension of the model by consideration of the nuclear moments of the lightest elements. To obtain complete agreement with experiment, the following assumptions are necessary :—

(1) The protons and neutrons are independently coupled to the central α-particle; as the α-particle has no spin, the nuclear moment is the difference of the resultant momenta of these two systems.

(2) The protons—attracted to the α-particle owing to the nature of the potential curve for small separations—form a quantised system the state of least energy ('ground term') of which may be predicted by analogy with the similar electronic system, the terms of which are inverted with respect to those of the proton system.

(3) For each neutron, the spin vector is parallel to, and coupled with, the orbital momentum vector. The neutrons form groups of two, with opposed total momentum vectors. In the p-shell, the contribution of each neutron to the resultant moment is $\frac{3}{2}\cdot\frac{h}{2\pi}$.

TABLE.

Nucleus.	Structure.	Component Moments. Neutrons.	Component Moments. Protons.	Nuclear Moment (I).
H1	π	—	$\frac{1}{2}$	$\frac{1}{2}$
He4	α	—	—	0
Li6	$\alpha+\nu+\pi$	$\frac{3}{2}$	$\frac{3}{2}$ ($^2P_{3/2}$)	0
Li7	$\alpha+2\nu+\pi$	0	$\frac{3}{2}$ ($^2P_{3/2}$)	$\frac{3}{2}$
C12	$\alpha+4\nu+4\pi$	0	0 ($^3P_0$)	0
N14	$\alpha+5\nu+5\pi$	$\frac{3}{2}$	$\frac{1}{2}$ ($^2P_{1/2}$)	1
O16	$\alpha+6\nu+6\pi$	0	0 ($^1S_0$)	0

π = proton; ν = neutron.

As the table shows, this model accounts for all the observed moments of the nuclei up to O^{16}—where the p-shell is completed. It is very striking that the nuclear moments of Li^7 ($I=\frac{3}{2}$) and N^{14} ($I=1$) are no longer exceptional.

It is at present not possible to predict the behaviour of the protons in the d-shell, as the screening effect of the six protons of the p-shell is greater than the attraction of the central charge (+2 units).

E. GWYNNE JONES.
University College,
Nottingham.
Sept. 15.

[1] J. H. Bartlett, Jr., NATURE, 130, 165; 1932.
[2] W. Heisenberg, Z. Phys., 77, 1; 1932.

Absorption of Sound by Porous Materials

SOME time ago, there was a discussion[1] between E. T. Paris and Heyl concerning the dependence of the absorption of sound upon the angle of incidence, which, however, produced no solution to the problem. Since for many practical purposes dependence of absorption upon angle and frequency is very important, investigations have been undertaken in this direction, which confirm qualitatively the angle theory of Rayleigh and Paris and a frequency theory proposed by us.

The relation of absorption to angle of incidence was measured in the open air on the flat roof of the institute. Loudspeaker and microphone were placed directly upon the floor. The sound reflected from the specimen under test was measured and compared with that from a completely reflecting plate (for example, a thick glass plate).

The frequencies used lay between 1,000 and 10,000 Hz., the angle of incidence lay between 10° and 75°. The following materials were tested: Tentest, Celotex B and BB, cotton wool and acoustic board. These materials were generally mounted upon plates of absorbing materials (Insulite). Particularly interesting is a material which functions according to the assumptions of Rayleigh, that is, which consists of a series of parallel lying channels constructed from corrugated paper. By closing a varied amount of surface, for example, changing the number of

channels, the porosity was altered from 0·2 to 0·99. The curves measured for the frequency 5,000 Hz. are reproduced in Fig. 1. These curves correspond in the measured range to the theory of Rayleigh and Paris. For the above mentioned materials, curves were obtained in the specified frequency range, which have the form of the theoretical curves for small and intermediate porosities; cotton wool has curves corresponding to a large porosity.

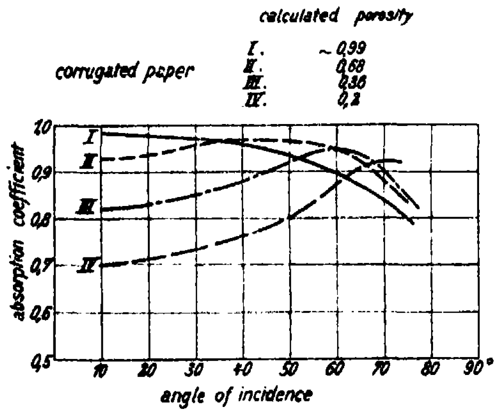


FIG. 1.

Secondly, the dependence of absorption upon frequency was tested. The acoustical impedance was measured for normal incidence in a tube with the help of an electrostatic vibrometer. Theory and experiment show, that the real part of the characteristic acoustical impedance (for infinite thickness) decreases with increasing frequency from a large value to a limit, while the imaginary part decreases to zero. The limit is given theoretically by the expression $\frac{Z_0}{P}$; where Z_0 = acoustical impedance of air and P = porosity. The characteristic limiting impedance of porous materials is always larger than that of air; it follows that a maximum must exist in the above mentioned curves showing the dependence of absorption on the angle of incidence, which is given by the relation $\cos\theta_{\max.} = \frac{Z_0}{Z}$ (Z = impedance of the material). The absorption coefficient increases continuously to a limit and has, therefore, on account of porosity alone no maximum. Selective absorption is explained by interference due to limited thickness. This effect has also been investigated.

Details of this work will be published towards the end of this year in the *Elektrische Nachrichten-Technik.*

VIKTOR KÜHL.
ERWIN MEYER.
Heinrich-Hertz-Institut
für Schwingungsforschung,
Berlin NW 87.
Aug. 10.

[1] NATURE, 126, 9, 350, 880; 1930.

Efficiency of Geiger Counter and Absorption of Cosmic Rays

THE efficiency of a Geiger counter may be defined as the probability of excitation when the counter is traversed by a high speed electrified particle. A determination of the efficiency for cosmic rays may be obtained in the following way. Imagine three counters 1, 2, and 3, which are placed with their axes in the same plane and their centres in the same (vertical) line. Let n_{13} be the number of coincidences between 1 and 3 and n_{123} the number of triple coincidences. The efficiency of the counter 2 is then determined by $n_{123} : n_{13}$.

In the experimental arrangement the dimensions of the counters were 5 cm. × 20 cm.; the counters were filled with air at a pressure of 4–9 cm. of mercury. The central electrode was a steel wire treated with nitric acid. The counters were placed in a vertical plane with a distance of 15 cm. between their axes; lead blocks 7 cm. × 10 cm. × 20 cm. could be placed between the counters. Below and on the sides the whole arrangement was screened by 10 cm. of lead in most of the experiments. The method used for recording coincidences has been described previously.[1] It consists essentially in imparting the impulse delivered by the counter to the mirror of an oscillograph. When coincidences between two counters are recorded, the deflections of the two mirrors are crossed, so that when a coincidence occurs the actual deflection makes an angle of 45° with each of the single deflections. In the present experiment it was necessary to use four oscillographs in order to record coincidences between three counters. The deflections of the four mirrors were crossed in such a way that the three possible kinds of coincidences, namely, 1-2, 1-3, and 2-3, were all recorded on the same film.

The smallest time difference which can be detected by this method is 2×10^{-4} sec., corresponding to one-tenth of the duration of the impulse. The number of single impulses from each of the counters was about eighty per minute, the number varying somewhat with the experimental conditions. This gives for the number of accidental coincidences between two counters 0·05 per minute, and for the number of accidental triple coincidences $2{\cdot}4 \times 10^{-5}$ per minute. The number of coincidences actually observed was for neighbouring counters about five per minute and for triple coincidences one per minute. The corrections for accidental coincidences are thus very small.

When the counters were operated at a potential a few volts above the lower limit of the sensitive range of voltage, about half of the coincidences 1-3 were triple coincidences, or, what is the same, the efficiency of the counter 2 was 50 per cent. At a potential 30 volts higher the efficiency was 85 per cent. The statistical material was too small for giving accurate numerical values, but in all experiments the same general result was found, the efficiency approaching unity at the upper limit of the sensitive range of voltage.

The justification for considering the efficiency as a property of the counter and not of the exciting radiation lies in the fact that the results were only determined by the voltage of the counters, and not by the presence or absence of the lead absorbers between and on the sides of the counters. This result has some bearing on the problem of the nature of the cosmic rays. If the cosmic rays were of electromagnetic nature, it seems very difficult to account for the values of efficiency actually observed.

J. C. JACOBSEN.
University Institute for Theoretical Physics,
Copenhagen.
Sept. 5.

[1] NATURE, 128, 185; 1931.

Spectrum of Cosmic Radiation

WITH respect to the formula suggested by Dr. A. St. Skapski in NATURE of Sept. 24, p. 472, it is of interest to note that such a formula can be deduced from the classical equations of Maxwell without reference to wave mechanics (*Proc. Roy. Irish Acad.*, vol. 41, A, No. 2).

ARTHUR W. CONWAY.
University College, Dublin,
Sept. 27.

The Contribution of Science to the Future

THE leading article under the above title in NATURE of Sept. 3 is a timely reminder of the outstanding problem of the present age. When science begins to question what is being done with its lavish gifts to humanity, it is a healthy sign, and gives grounds for hope that something may be done towards solving the greatest anomaly of our time—that of scarcity in the midst of abundance, and its attendant evil, unemployment. It is, too, a sign of awakening to the realities of the situation that there were echoes of this question at the recent meeting of the British Association—notably in the president's address and in the suggestive address by Prof. Miles Walker on "The Call to the Engineer and Scientist". Moreover, there are not lacking other signs in various directions that this question is becoming a live issue, and one that must be grappled with, and that quickly.

The question arises, What is the best way of following up these finger-points, and translating them into action?

It may I suppose be laid down as a general proposition that the fruits of science—and they are many—ought to be made available to the community, free of any exacting toll, and in such a way that the benefits are distributed as evenly as possible to every member of the community. Efforts should be directed towards seeing that there is no loss of efficiency between the findings of science on one hand, and their application to human life on the other. Here, if anywhere, should be evidence of the 'conservation of energy' on its highest plane.

Thanks to science, the problem of production has been solved, and by means of a policy of rationalisation, costs have been reduced to a minimum. On the *distributive* side, however, there has been no corresponding advance or change. In the midst of an otherwise changed world, we continue to pursue the same outworn methods of our forefathers of 150 years ago, relying upon the inertia of the past to carry us through.

This disequilibrium between the productive and distributive side of industry, which is the root of the problem, must be righted if civilisation is to reap the benefits of scientific progress. Here more than anywhere else is abundant scope for rationalisation in the proper sense of that rather hackneyed term. Nothing indeed could be more irrational than the existing state of affairs.

The fact is, there has been a sad lagging behind the advance of science on the part of what may be termed the non-scientific world, that is, the ethical and spiritual, and we might add, the political. There has been no preparing of the ground for the coming of the gifts of science, and the result is that much that should otherwise have been a benefit to mankind has simply led to social chaos.

As to what is to be done, a humble suggestion may be hazarded. In these days of over-specialisation, when the general is apt to be lost in the particular, should not an attempt be made to co-ordinate all the leading forces of to-day—scientific, ethical, industrial, political, etc.—by forming some sort of general council, the object of which would be to concentrate upon this special problem of how Nature's gifts, as revealed by science, can best be applied to the welfare of mankind; to plan definitely, and if need be to create, a new order of society, fitted to receive, and make adequate use of, our newly found powers; and further, to tackle the correlative problem of providing for the proper use of that leisure which may be expected to be the outcome of a proper use of Nature's bounties? The one essential qualification for members of such a council would be the possession of those qualities of mind referred to in the article: it may, perhaps, be summed up in freedom from the inertia and prejudices of the past, and an open mind towards the future. The recommendations of such a council could, I feel sure, be made to carry weight in political quarters, and so in time filter through into national life.

Prof. Walker's suggestion of an experimental self-supporting colony under scientific supervision is also worthy of attention.

One is tempted to reflect that if some self-sacrificing genius could be found to devote as much, or even a tithe of the attention and research upon this seemingly recalcitrant problem as is concentrated upon, say, the breaking up of the atom or the origin of life, a solution would not be long in being forthcoming. Is it too much to hope that some such genius may one day be found?

W. E. LISHMAN.

Stocksfield, Northumberland,
Sept. 15.

A Biological Conversion of Glucose to Glucosone

WHEN the fully developed mycelium of a certain mould belonging to the flavus section of the *flavus-oryzae* group of Aspergilli, is allowed to act upon a 5 per cent solution of glucose in the presence of a small quantity of toluene, I have observed that glucosone is produced. This may be detected in the medium when the experiment has been allowed to proceed at a temperature of about 27°–28° for several days, the presence of the glucosone being demonstrated by the fact that addition of phenylhydrazine acetate in the cold gives rise immediately to a precipitate of glucosazone. A 5 per cent solution of glucose on treatment with phenylhydrazine acetate in the cold does not yield immediately a precipitate of glucosazone.

The glucosone was also characterised as an azine, which was formed when *o*-phenylenediamine was added to the medium from the culture flask. The derivative melted at 194°–195° and proved to be identical in appearance, composition and behaviour, with the azine obtained by treatment of a solution of authentic glucosone with *o*-phenylenediamine. A mixture of the two specimens also melted at 194°–195°.

This formation of glucosone from glucose under the influence of an enzyme or system of enzymes present in a mould is not without interest in view of the suggestion made by Hynd[1] that the first step in the utilisation of glucose in the animal body is oxidation to glucosone, insulin being presumed to act as an oxidase catalysing the conversion.

Further study is being made of the conditions under which this transformation can be effected by biological agency.

T. KENNEDY WALKER.

College of Technology,
University of Manchester.

[1] *Proc. Roy. Soc.*, B101, 244; 1927.

Research Items

Celtic Art in Britain.—A counter theory on Celtic art to that developed by Mr. T. D. Kendrick in his recent advocacy of a Romano-British source for the hanging bowl (see NATURE of July 2, p. 27) is put forward by Dr. R. E. Mortimer Wheeler in *Antiquity* for September. Two main phases of Celtic art in Britain are recognised, a pagan Celtic art beginning in the fifth century B.C., and ending in the second century A.D., and a Christian Celtic art beginning in the sixth century A.D., and lingering on until about the ninth century. Though linked by an essentially similar informing spirit, they are separated by a hiatus of three centuries, a feature rare in the history of a single school of art. Further, when Celtic art reappears after the hiatus, it is not in the dominantly Celtic parts of Britain, but in the pagan Saxon area. Taking the distribution of pagan Celtic art in time and space, it reaches its zenith during the first century B.C., coinciding with the area in which political authority in the island was consolidated, indirectly and afterwards directly, under Roman rule, while north of the Humber the northern school of this art awaits the settled conditions of the second century A.D. In the Christian phase, it was the Saxon settlement and the Saxon peace which afforded the Celtic craftsman the security and leisure he needed for the development of his art, while he was free from the competition of Roman mass production. On this line of thought the sequence of Celtic art becomes logical. On four occasions the Celtic artist was in a sympathetic environment. First in the Belgic and earliest Roman occupation; secondly during the earlier Roman occupation of northern Britain; thirdly during the Saxon settlement of central and southern Britain; and fourthly during the regime of a strong and wealthy church in Ireland; that is, four periods when political and economic security were forced upon the Celts.

Gods of the Acoma.—The Acoma Indians of New Mexico were first visited by whites when Capt. Alvarado was sent on an exploring expedition from Zuñi (Cibola) by Coronado in 1540. They then earned a reputation for unfriendliness which they have maintained until the present day. A study of their culture has recently been published by Mr. Leslie A. White (Forty-seventh Ann. Rep. Bur. Amer. Ethnology). At the head of their pantheon stands Ocato, the sun, the chief of supernaturals. With him are his two sons, Masewi and Oyeyewi, the twin war gods, symbolising courage, strength, and virtue. They are rainmakers and were the leaders of the Acoma people when they lived in the north. Anthropomorphic spirit rainmakers live in the west and are of the greatest importance in ceremonial. Mysterious spirits who dwell in the sunrise strengthen the weak and the sick. Most important of all, however, is Iatik, the great mother, the symbol of human life, but remote from the daily activities of her children. After death the individual goes back to her; but she is never pictured as human in form. The moon and stars are said by some to be spirits; while the clouds, especially the rain clouds, are important and prayers are said to them. Lightning is a symbol of power, and flints are called 'lightning stones'. Four rainmakers live at the cardinal points, each bringing a different type of wet weather. There are also hunting and medicine gods, and with them are San Estevan, Yoshthi, Dios (or God), and Christo. These are a survival of the Spanish conversion of the Acoma to Christianity. Dios is not considered well-disposed towards the Acoma, because he punishes after death, which the other gods never do. Prayer sticks are sometimes offered to him, but always accompanied by prayer sticks for the great mother, Iatik.

Insects attacking Hardwood Timbers in Great Britain.—The Department of Scientific and Industrial Research has recently issued a practical brochure entitled "A Survey of the Damage caused by Insects to Hardwood Timbers in Great Britain", by Dr. R. C. Fisher and Messrs. F. R. Cann and E. A. Parkin (Forest Products Res. Bull. No. 16. London: H.M.S.O. 2*s*. 6*d*. net). The losses incurred through attacks of beetles, mainly *Lyctus* powder-post beetles, by all branches of the hardwood timber trade, are increasing. The spread of native and imported species of *Lyctus* in timber stores is such that they now occur in almost every yard and workshop in which susceptible timbers such as oak, ash, walnut, and elm are used. The most reliable method of eliminating *Lyctus* infestation is by kiln sterilisation, in which the timber is heated up to a definite temperature in a moist atmosphere. The Forest Products Research Laboratory, which is responsible for this publication, considers that immediate steps should be taken to control the spread of *Lyctus* beetles in Great Britain. Co-operative action by all trades concerned would result in a widespread demand for kiln-sterilised wood, or wood otherwise free from attack. The bulletin contains the latest information on the *Lyctus* problem and recommendations to trades anxious to diminish losses from this source. It also gives information of the types of injury caused by other insects, and methods of distinguishing them. Unlike *Lyctus*, however, these do not survive the seasoning of the timbers.

Chromosome Numbers of the Genus Crocus.—The study of chromosome numbers is becoming of increasing interest. Mr. K. Mather (*Genetics*, vol. 26, No. 1) has made a comparison of the somatic chromosomes in many species of *Crocus* and finds every haploid number between 3 and 15 in this genus, which reproduces annually by forming corms. There is considerable differentiation between the chromosomes of a group, satellites and constrictions being present. There is also evidence of chromosome fragmentation in certain species. Although the haploid numbers form a continuous series, as in *Cyperus*, yet there is also evidence of polyploidy in certain species of *Crocus*, and some species and varieties are clones with an odd number of somatic chromosomes. Fusion of chromosomes may have been concerned in producing such low haploid numbers as 3 or 4. The genus also differs from *Crepis* in that no chromosome number is common to a large number of species. Measurements show that the total bulk of chromatin in the chromosomes may be from five to seven times as great in some species as in certain others with a higher chromosome number. In general, as the number of chromosomes increases there is a decrease in their length and an increase in their size differentiation. This work furnishes the beginning of an important study in chromosome phylogeny.

Maturity of Fruit.—An intensive investigation of the factors affecting the maturation of fruit is being

prosecuted by several members of the Long Ashton Fruit and Cider Institute. Dr. J. C. Hinton reviews the literature on the subject (Ann. Rep. of the Institute, 1931, pp. 40-53), and gives some interesting results of measurements made by a hardness tester. He finds that the rate of softening of later-picked fruit is greater than with earlier-picked produce. Apples from ringed trees and from grass orchards soften more slowly than fruit from cultivated fields, most probably because they have larger quantities of solids, and particularly carbohydrates. The same author reviews the problem from another angle in a later paper (pp. 54-67) of the same report. Extensive data as to the relative amounts of sucroses and hexoses are coupled with the results of starch tests at picking time, and lead to the general conclusion that fruits with a relatively favourable food supply ripen slower than those with a less favourable nutrition. This is, however, complicated by the special cases when potassium is deficient or when the tree is ringed or thinned, for the generalisation does not then hold. Messrs. J. C. Hinton, J. O. Jones, and F. C. Lewis have investigated the influence of position in the cluster on the quality of apples, pp. 68-76). Lateral fruits had more sucrose and lost weight quicker during storage than terminal fruits. Thinning to one fruit per cluster produced an increase in sucrose content of all fruits. Ash constituents were apparently not affected by thinning treatments.

Oxygen Intake of Living Tissues.—Dr. T. A. Bennett-Clarke (*Sci. Proc. Roy. Dublin Soc.*, vol. 20 (N.S.), No. 23, pp. 281-291) has described a method for recording automatically the oxygen intake of living tissues. The suggested method, based on that of Fernandes, embodies certain novel technical features which render it insensitive to changes in atmospheric pressure and include an automatic device for replacing the oxygen utilised by the tissue with oxygen electrolytically produced and introduced into the otherwise closed gas circuit. A specially constructed gas circulating pump which ensures a flow free from pulsations is described in some detail. Details of the methods used for carbon dioxide estimation are given. The methods have been applied (loc. cit. No. 23, pp. 293-299) to a study of the respiratory quotients of succulent plants. The changes with time of the oxygen absorption and carbon dioxide production of excised leaves of *Sedum prealtum* were determined and their theoretical significance discussed.

Thunderstorms and Penetrating Radiations.—Whereas C. T. R. Wilson has suggested that very penetrating radiations may be produced during thunderstorms, B. F. J. Schonland in 1930 reported that he had observed a screening effect due to thunderstorms on the ordinary fine weather penetrating radiation. As mentioned in a letter in NATURE of Sept. 10, p. 399, he has since confirmed this by further observations. Prof. G. B. Rizzo, of the Geophysical Institute, the University, Naples, writes to report a similar observation made on August 27, 1932, on Rocciamelone Mount, 3537 metres above sea level. During a very powerful thunderstorm, from $14^h\ 40^m$ until $18^h\ 20^m$ (M.E. mean time), there was a distinct diminution in the number of ion pairs formed per sec. per cm.^{3} inside an iron shield 5 cm. thick, placed in an alpine refuge, wooden roofed and covered with 1 mm. galvanised iron plate. The measurements, made with a Kolhörster electrometer (by Günther and Tegetmeyer) showed a reduction from 7·70 pairs before the storm, and values oscillating about 7·60 after the storm, to values of 7·05 during the storm.

The Velocities of the Ions Striking the Cathode of a Discharge Tube.—In the glow discharge an important part is played by the bombardment of the cathode by positive ions. This bombardment is an important mechanism in maintaining the supply of electrons for the discharge. The velocity distribution of the ions passing through a hole in the cathode has been roughly examined by the Doppler effect in spectral lines emitted by the canal rays, and by the intensity distribution in the J. J. Thomson parabolas, and some particles were found having velocities corresponding to nearly the full cathode fall of potential. Chaudri and Oliphant (*Proc. Roy. Soc.*, Sept.) describe experiments in which the beam of ions passes through a hole in the cathode into a space which is kept free from gas by a fast diffusion pump. The velocity analysis is then carried out by the electrostatic focusing method of Hughes and Rojanski. The velocity distribution curves show a maximum for a rather low energy (of the order of a quarter of the total cathode fall of potential)—with a sharp decrease at lower energies and a more gradual fall towards higher energies. Some ions were found with energies corresponding nearly to the full cathode fall, and it seems that these ions must go through the cathode dark space—about 20–100 mean free paths for molecules—without losing energy by collisions. The authors give a partial explanation of their results in terms of the ionisation efficiency of electrons and the consequent distribution of ionisation in the dark space. The peak in the velocity distribution they explain tentatively by invoking the exchange of charge (Kallmann and Rosen) between the fast ions and slowly moving gas atoms.

The Accommodation Coefficient for Helium on Tungsten.—In a paper in the September *Proceedings of the Royal Society* Jackson and Mott apply quantum mechanics to the problem of the collision between gas atoms and a solid surface. The latter is treated as an assembly of independent atoms which vibrate about a position of equilibrium. The energy of interaction of a gas and a solid atom is supposed to vary exponentially with the separation. The probabilities of energy transfers are calculated, and from these the thermal accommodation coefficient is deduced. The formula derived contains the 'characteristic temperature' of specific heat theory and a parameter characterising the law of interaction between gas and solid atoms. The formula fits well to Roberts's experimental curve connecting temperature and accommodation coefficient for helium on clean tungsten, when the one arbitrary parameter is adjusted for one temperature. The value of this parameter fits in with ordinary ideas of atomic dimensions.

Testing Strings of High-tension Insulators.—The high-voltage transmission cables used for the transmission of electric power are supported by 'strings' of insulators to the lattice towers. These strings have always to withstand very high electric pressures and sometimes owing to atmospheric and other disturbances a 'flash over' occurs and the string may be left in a damaged condition, one or more of the

insulators being punctured. To avoid interruption to the supply it is advisable to test the insulators at periods varying from six months to two years depending on special conditions. To the *Electrical Times* for Sept. 22 Mr. G. A. Robertson contributes a useful article on the new methods which are coming into use for detecting these faulty insulators. Some of the methods seem crude but are none the less effective. The 'buzz-stick' method, for example, consists of a long stick made of bakelite, an excellent insulator, with a pointed metallic object on the top shaped like a hay fork with an extra metallic prong at right angles to the two other prongs. If when holding the eight-foot stick at the insulated end the extra prong is made to touch the 'live' cable and then drawn slowly away, a buzzing noise is heard the loudness of which depends on the rate the fork is moved away and on the voltage of supply. The prong is then applied to the caps of the various insulators in turn and drawn away at the same rate. The sounds heard should vary according to the normal distribution of potential along the string. The next test is to bridge each insulator in turn by the two prongs of the fork. When they are sound, short snappy sparks are produced, the intensities varying with the potential distribution. When an insulator has been perforated no spark occurs and so it is detected.

North American Game Birds.—The ninth of the valuable series of bulletins on the life-histories of North American birds, published by the United States National Museum, concerns the gallinaceous birds (orders, Galliformes and Columbiformes), and on that account is of more than usual interest to the general reader (*U.S. Nat. Mus. Bull.*, 162). It is the first of the series in which any considerable number of subspecies had to be dealt with, but technical descriptions are reduced to a minimum, and the author, Arthur Cleveland Bent, has made full use of historical data and of the observations of habits made by correspondents. Some notion of the scale upon which the volume is written will be gathered from the fact that 24 pages are devoted to the extinct passenger pigeon, and almost 16 to the heath hen, one among the first of the American birds to be mentioned in the writings of the early colonists, and now apparently represented only by a single aged male individual living in Martha's Vineyard Island, Mass.

Astronomical Topics

Theories of the Evolution of Binary Stars.—*Revue Scientifique* for July 23 contains a discussion on this subject by Dr. P. Baize. He first discusses the capture theory, which imagines the chance approach of the two stars, constrained either by collision with each other or with secondary bodies of their systems to remain in company; it is easily shown that such collisions or appulses would be too rare to explain the immense number of binaries. The theory of neighbouring nuclei in a nebula, favoured by Sir James Jeans to explain the binaries of long period, does not meet with much favour from Dr. Baize. He suggests as an alternative an explosive expulsion from the primary, and refers in support of this view to the companion bodies of Nova Pictoris. But the products of such explosions would either recede indefinitely or would intersect the parent star on their return. Perturbations might prevent actual impact, but it would be a long step from such perilous near approaches to the safe and stable orbits of most of the known binaries. The theory of fission of the primary through rapid rotation, favoured by many cosmogonists to explain the spectroscopic binaries and other close pairs, is taken by Dr. Baize as the general mode of origin of most binaries. He is aware of the immense gap that intervenes between the initial small circular orbits and the large elongated ones, with periods of centuries, of many visual binaries; but he conjectures that loss of mass through radiation, and possible disturbances by passing stars, might bring this about in the billions of years (he says trillions, but he means British billions) which he postulates for the life of the stars.

Exception must be taken to a sentence of the article: "Les étoiles du type 61 Cygni dont le mouvement relatif s'exécute en ligne droite. . . ." It was shown first by Peters, then by T. Lewis, lastly by A. Fletcher (*Mon. Not. Roy. Astro. Soc.*, Dec. 1931), that the motion of 61 Cygni is not rectilinear, but in an ellipse with a period in the neighbourhood of seven centuries.

Report of the Cape Observatory for 1931.—This report contains an account of much important work; that relating to the observations of Eros is of special interest. The unexpectedly large deviation of Eros from its predicted place necessitated the selection of some new stars of reference; stars from both the old and new lists have been well observed at the Cape. Stars in the zone $-30°$ to $-35°$ are being observed as reference stars for the photographs taken of this zone; a new list has been prepared of stars down to mag. 7·5 between the equator and $-30°$. 475 plates of Eros were obtained with the Victoria telescope and 678 plates with the astrographic one; the latter are fairly equally divided between large easterly hour-angles, small hour-angles, and large westerly ones. Plates were also taken with a wire grating, to detect stars of outstanding colour-index, and others for obtaining positions of the reference stars. Eros was photographed until May 1931, to provide material for Prof. Gustav Witt, who is revising the orbit.

Observations of the outer planets with the heliometer were continued; the results will be published when revised positions of the comparison stars are available.

The report contains a note on changes in the spectrum of Nova Pictoris, of which a spectrogram was taken at the Union Observatory, Johannesburg, in February 1931. Two lines of unknown origin, at 6088 and 5722, were the strongest; then followed the line $H\alpha$, and that at 4686, due to ionised helium; there was no trace of the nebular emissions, N_1 and N_2, which were present, but weak, in 1928. The year 1931 was a dry one at the Cape, the rainfall being 19·09 inches, which is 5·28 inches below normal; the mean temperature was 63·8° F., which is 1·4° above normal.

Minor Planets.—Circular No. 653 of the Berlin Rechen Institut assigns permanent numbers to fifteen new planets discovered between 1927 and 1932; three of these proved to be identical with planets observed, but not numbered, in earlier years. The new numbers run from 1209 to 1223. The interesting planet discovered by M. Delporte at Uccle last March, which comes nearer to the earth than Eros, receives the number 1221 and the name *Amor*; this was doubtless chosen as suitable for a companion of Eros.

Conference of the Association of Special Libraries and Information Bureaux

THE ninth annual Conference of the Association of Special Libraries and Information Bureaux, which was held at Somerville College, Oxford, on Sept. 23–26, opened and closed on a note echoed from the British Association meetings at York. In an opening address to the Conference on Sept. 23, on "Science and the Humanities", Prof. J. L. Myres directed attention to three characteristics of our own age, in the abundance of information and of working tools or instruments as well as of those who use them, linked up with increasing opportunities of use and the growing complexities of organisation directed to make both more accessible, and suggested that the depression which accompanies this superabundance of means is possibly no temporary depression. The leisure state may well be upon us and it is difficult to predict what the new order will be. All that can be said is that the situation must be met with new ideas and new projects, and Prof. Miles Walker's address at the British Association meeting was essentially a challenge to the present order and to the general outlook. With this the Association of Special Libraries and Information Bureaux is concerned in the provision of information relating both to accurate knowledge of the world and to the training necessary to make people competent to live. Sir Alfred Ewing's presidential address at the York meeting of the British Association likewise issued a challenge to modern politics, economics and systems of education and raised the whole question of the relative value of science and the humanities both in society and in the preparation of people for its privileges.

Prof. Myres pointed out that while the scientific method makes its chief contribution to human welfare in the assistance it gives in the observation and interpretation of experience, scientific achievement is at once impeded by the absence of moral qualities and æsthetic or artistic taste, and the humanities or human sciences such as human biology, psychology, statistical economics, make an equally important contribution in training human qualities, and the activities of the individual. The development of self-consciousness and self-control is an important aspect in social relations, and full use of information presumes the discernment of individuality in ourselves as in others. Accordingly moral, political, economic and social methods have a geographical or distributional aspect as well as a historical aspect. This, together with the distributional aspects of the systematic sciences, which only become directly applied to life when local or temporal conditions are involved, cuts right across the traditional view of the humanities and even raises doubts as to whether any real distinction is possible between the human and the pure sciences. Prof. Myres suggested that the teaching of a systematic science should be humanised by paying more attention to its historical growth and regional application, and also that the teaching of the humanities might be clarified and intensified by a firmer distinction between their systematic aspect and those historical and regional reconstructions which alone can set the civilisations of the present in an intelligible perspective.

The same vigorous and refreshing outlook characterised the closing address to the Conference, in which, pointing out that the present depression is sapping moral as well as material resources, Mr. F. W. Pethick-Lawrence emphasised the importance of rational thinking on the situation and of discarding the old method of trial and error. Financial muddling is directly responsible for the crisis, and the way out of our difficulties lies in the intelligent use of accurate information, in treating finance not as an end in itself but as the handmaid of politics.

Comparing the present with previous Conferences, it is evident that the industrial representation is gaining strength and that despite its financial difficulties, the Association is steadily proving its worth and demonstrating the value of the co-operation which it has already established between special libraries and information bureaux. It is clear from discussions like that opened by Dr. S. C. Bradford on "Systematic Subject Indexes to Periodical Volumes" that there is still plenty of room for further co-operation. The intensely individualistic point of view of some special librarians or heads of information bureaux which was evidenced in this discussion probably deserves some of the strictures recently uttered against the expert and the specialist, and has sometimes led them to overlook practical advantages in the decimal classification. On the other hand, those most interested in securing the adoption of the universal decimal classification have sometimes failed to realise the practical and even financial difficulties which at present beset the application of the classification in certain sections of industry. It is perhaps a little unfortunate that the Association devoted so much time at its conferences to a subject on which there is a strong cleavage of opinion, particularly as, with the growth of co-operation, the practical advantages of the decimal classification for many purposes may be more fully appreciated.

The discussion centring round the decimal classification was somewhat marred by the absence of an impartial chairman, but if any criticism is offered of the following discussion on the establishment and operation of an information service, it is that the joint paper circulated in advance to the Conference was treated at such length by the four joint authors that little time was left for discussion. This was evidently felt by the meeting, for a resolution was passed and adopted at the final session of the Conference, asking for a similar discussion on particular aspects of information services, especially in regard to co-operation, to be arranged at future conferences.

The discussion was opened by Mr. A. F. Ridley, of the British Non-Ferrous Metals Research Association, who stressed the advantages of an efficient information service in handling a far greater body of knowledge than could possibly be handled haphazard by individuals. Such a service, while not relieving individual members of the organisation from the duty of reading and digesting all information of importance to their work, assists them by selecting for them to read the information bearing on their special work. This work is educative as well as informative, inducing members of the organisation to make better use of the facilities offered. Special emphasis was placed on the selection of staff, as although much of the work is routine, it must never be allowed to become too much so. A very real part of the business of an information service is to safeguard the organisation for which it works from

becoming hidebound with tradition. Initiative is of high importance, and the shortness of the time-lag between publication of information and its being brought to the notice of the individual needing it is largely a matter of adequate library, technical and clerical staff.

Miss E. W. Parker, of the Mond Nickel Co. Ltd., stressed the value of external literature surveys conducted outside the library as a means of supplementing information received in the library. Much valuable advance information can be obtained by co-operation and by contact with technical and scientific personnel all over the world. As regards bibliographical work, Miss Parker suggested that it is important to produce bibliographies in advance of the demand, and stressed the importance of attention to detail in such matters as well as in dealing with inquiries. It is doubtful whether any inaccuracies in such work can be described as minor. Mr. E. J. Carter emphasised aspects of the information service maintained by the Royal Institute of British Architects, stressing particularly the importance of maintaining a full service of journals and books inside the library and the value of propaganda regarding the services offered. Mr. T. M. Herbert described the information service recently developed as part of the research organisation of the London Midland and Scottish Railway.

An animated discussion, opened by Mr. J. P. Lamb, chief librarian to the City of Sheffield, with a paper entitled "The Public Library as an Aid to Industry and Research" and by Mr. B. M. Headicar with a paper, "Research: Where the Library and Librarian come in", focused attention on the general neglect of the municipal library by industry. Mr. Lamb referred to the possibilities of co-operation between the public libraries and special libraries in regard to co-ordination of purchases of books and the pooling of periodicals and storage space. In the course of discussion, Mr. Lamb directed attention to the changed conditions under which the reference library now operates and the necessity for some elasticity in adapting its former rigid procedure regarding the loan and exchange of books. Where local conditions permit rapid and easy book exchange a very useful field of co-operation between industrial and municipal libraries exists and a promising tendency is that towards the development of a pool of technical and specialised works between the strictly reference library and the general library.

Prof. M. Greenwood delivered a delightful paper on the "History and Sources of Official Vital Statistics" in which a keen sense of humour enabled him to make an apparently uninteresting theme eloquent and to convey to others something of the fascination the subject has for the expert as well as of the difficulties and pitfalls which beset those attempting to compare vital statistics or to base conclusions on them.

One of the most important discussions, to which very little time was allotted, however, was that initiated by Mr. A. A. Eldridge's report on the A.S.L.I.B. inquiry into technical and scientific abstracting. This inquiry was conducted by a small committee of which Mr. A. A. Eldridge was chairman and was the direct outcome of the informal conference convened by Mr. H. T. Tizard last year at the Imperial College of Science and Technology. The report presented by Mr. A. A. Eldridge was purely preliminary and outlined the general trend of the replies received to the questionnnaire. Some fifty replies had been received covering nearly all the important abstracting agencies in Great Britain, including research associations and imperial bureaux, the Department of Scientific and Industrial Research, the Royal Photographic Society, the Textile Institute, *British Medical Journal*, Bureau of Chemical Abstracts, Institution of Civil Engineers and various industrial firms like the British Aluminium Co. Ltd., J. Lyons and Co. Ltd., Imperial Chemical Industries Ltd., Metropolitan-Vickers Electrical Co., Ltd.

The report directs attention to the opportunity for co-operation in the purchase or examination of journals of secondary interest and distinguishes between overlap in preparation and unavoidable overlap in publication. The replies received in answer to the questions regarding the qualifications for abstractors and their selection should provide the Association with a valuable analysis of experience as a basis for useful suggestions in response to definite requests for help. Divergent opinions were expressed as to the value of authors' summaries where provided, and opinion was expressed in the discussion on the report that abstracts must be written from the point of view of the user for whom they are intended. This is particularly true of the industrial abstracting services, but such services are frequently run deliberately to supplement and not to replace the work of agencies like the Bureau of Chemical Abstracts and the view that abstracts are best contributed by specialists in a particular field finds little support in industry. The discussion suggested that full time abstractors who are generally familiar with the subject and its principal complexities are regarded as most satisfactory for the special libraries or information bureaux. Attention was also directed to the desirability of uniform practice in regard to the abbreviations used for journal references, etc., and the transliteration of names in non-Latin scripts, as well as to the difficulties in the way of co-operation presented by the introduction of abbreviations into the text of abstracts.

At the annual meeting, discussion on the report and on what members want of A.S.L.I.B., initiated by Mr. H. Robinson of the Textile Institute indicated a very lively appreciation of the valuable work which the Association is carrying out and the wide and useful field of co-operation open to it. Sir Charles Sherrington was elected president of the Association in succession to Mr. H. T. Tizard.

A Census of Summer Thunderstorms

THE first annual report of the Thunderstorm Census Organisation, Langley Terrace, Huddersfield, deals statistically with the records obtained, largely with the aid of private observers, during the six summer months April–September of 1931. It is an amateur enterprise conducted by Mr. S. Morris Bower as a sequel to a similar investigation carried on during a long period by Mr. C. J. P. Cave into the occurrence of thunderstorms in winter. The British Rainfall Organization, which is now part of the organisation of the Meteorological Office, Air Ministry, no doubt began in much the same way to supply information about one meteorological element with a greater degree of detail than could possibly be done without the aid of voluntary observers. The demand for such detailed information about

rainfall on the part of engineers occupied with water supply is considerable and fully justifies a permanent organisation of that kind; whether the same will be found in the case of thunderstorms as a result of electrical developments, wireless transmission, and aviation, remains to be seen.

The response to this enterprise has been very good for it is stated in the foreword to this report that 966 voluntary observers and organisations have contributed to it. The only criticism that suggests itself is that the working up of the statistical material does not appear to promise any notable advance in our knowledge of the conditions favourable for the development of thunderstorms, or of their life history. Great accumulations of statistical information of this kind abound in meteorology, but it only too often happens that nobody comes forward to extract new knowledge from them.

Nothing in the way of a generalisation is suggested by this report except that the regions of maximum frequency of winter thunderstorms—the western coasts of Scotland and Ireland—are roughly those of minimum frequency of summer storms. This is not new knowledge; it has been recognised with the aid of a comparatively moderate number of regular official observing stations, and the explanation is furnished by ordinary synoptic meteorology, when due attention is paid to the possible ways in which atmospheric instability can arise at the two seasons. It seems reasonable to suppose that real advance will necessitate a study of selected portions of this detailed statistical information on correspondingly detailed synoptic lines in the endeavour to trace the physical processes that accompany the development and decay of individual storms or systems of storms.

Mathematical and Experimental Evidence for the Existence of a Central Intellective Factor*

By DR. WILLIAM BROWN

If a number of sufficiently dissimilar mental tests of intellective ability be applied to a group of individuals and correlation coefficients calculated, it is found that these correlation coefficients are related to one another in such a way that for any four (or *tetrad*) of them the following relation holds good within the limits of random sampling:

$$r_{ap}\, r_{bq} - r_{aq}\, r_{bp} = 0;$$

and similarly with other arrangements of these four coefficients. We owe both the discovery of fact and the devising of the tetrad criterion to Prof. C. Spearman.

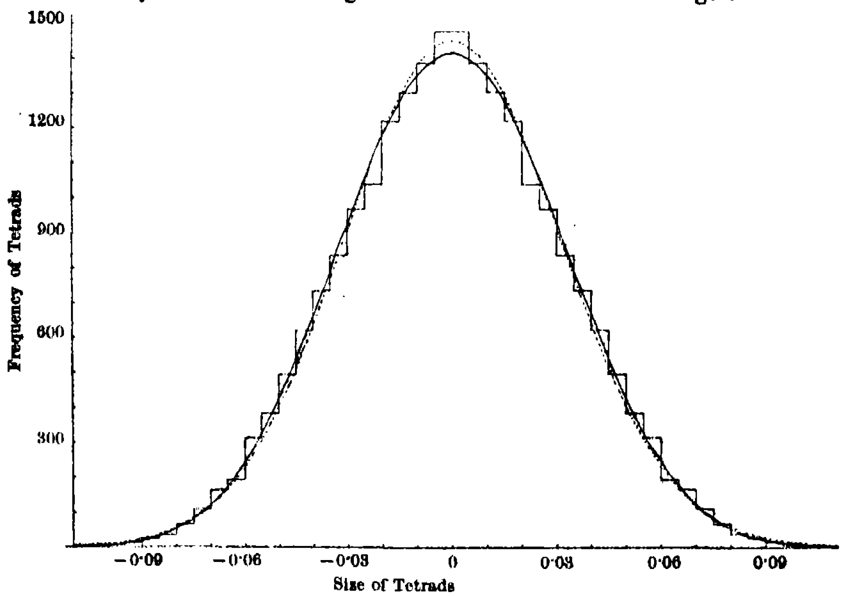


FIG. 1. Frequency distribution of tetrad differences. Best-fitting curve (Type IIa Pearson Curve) ———. Best-fitting Probability Curve ....

The inference drawn from this is that the abilities measured by the mental tests are divisible into two factors each, one being common to all (the general factor, g), while the other is in each case specific and independent (the specific factor, s).[1]

The method of applying the tetrad criterion is to draw up a frequency distribution of all the possible tetrad differences derivable from the table of correlation coefficients ($6 \times {}^nC_4$ in number, where n is the number of mental tests correlated with one another), and to compare its standard deviation with the 'theoretical' standard deviation of a purely chance distribution of such tetrad differences. A formula for the latter has been calculated by Spearman and Holzinger.

I have re-tested my earlier correlation results of twenty to twenty-three years back[2] by this criterion, and find that, so far as they go, they do support Spearman's two-factor theory. But a statistically adequate proof of the theory needs a large random sample of cases (several hundreds) and, especially, a large number of not too similar mental tests of intellectual ability—much larger than those applied in any research up to the present date.[3]

To fulfil these conditions, I have organised a research during the past year with the help of Prof. Spearman and Dr. W. Stephenson of University College, London. Dr. Stephenson has devised a series of twenty tests of apparently non-overlapping intellective ability, selected not *a priori* but after much preliminary trial, which received the approval of Prof. Spearman, and has applied them for me to 300 boys, aged 10½–11 years, drawn from twelve elementary schools of the L.C.C., forming a homogeneous random 'sample' of adequate size for statistical purposes. The total number of positive tetrad differences is 14,535 (and there is an equal number of negative tetrad differences, of course). It has since been found necessary to reject one of the tests and one of the correlation coefficients. There remain 11,356

* Summary of a paper read on Aug. 24 to the Tenth International Congress of Psychology at Copenhagen.

positive tetrads (and an equal number of negative ones) which form a smooth frequency curve, the mathematical properties of which I am now working out.

I have found that the best-fitting frequency-curve is a Type IIa Pearson curve, with equation

$$y = 1412\left(1 - \frac{x^2}{1188}\right)^{13 \cdot 669} \text{ [unit of grouping} = 0 \cdot 005]$$

The curve is platykurtic, with $\beta_2 = 2 \cdot 81446$. (For a 'probability' curve, $\beta_2 = 3$). $\chi^2 = 20 \cdot 69494$ (for 21 groups), and therefore $P = 0 \cdot 41537$,—a good fit. The standard deviation, $\sigma_t = 0 \cdot 031289$.

If we compare this with the 'theoretical' Spearman-Holzinger value[4], $\overline{\sigma}_t = 0 \cdot 02827 \pm 0 \cdot 002586$, we find an excess of $0 \cdot 003019$, which is $1 \cdot 167$ times the probable error. This means that the odds are about 4 to 3 against such a deviation,—a good correspondence of observation with theory.

The best-fitting *probability curve* to the distribution is

$$y = 1448 \, e^{-x^2/78 \cdot 32}$$

This is far less good a fit than the Type IIa Pearson curve above-mentioned, since for it $\chi^2 = 39 \cdot 21517$, and therefore $P = 0 \cdot 0114809$,—a poor fit.

The small size of P is partly due to the large number (21) of groups in each half of the frequency-distribution. Actually both curves appear to fit the distribution closely, when superposed upon it, and the superiority of the Type IIa curve only becomes visually apparent in a large-scale drawing, such as would be too large to reproduce here.

[1] Spearman, C. "The Abilities of Man". London, 1927, pp. 74, 75.

[2] Brown, William. "The Essentials of Mental Measurement", First Edition 1911, Cambridge, pp. 114, 116.

[3] Pearson, K. and Moul, M. "The Mathematics of Intelligence. I. The Sampling Errors in the Theory of a Generalized Factor." *Biometrika*, vol. 19, p. 261, Dec., 1927.

[4] Spearman, C. and Holzinger, K. "The Average Value for the Probable Error of Tetrad Differences". *Brit. J. Psychol*, vol. 20, part 4, p. 370, April, 1930.

University and Educational Intelligence

BIRMINGHAM.—Prof. W. Stiles has been elected dean of the Faculty of Science to succeed Prof. S. W. J. Smith whose term of office has expired.

OXFORD.—Dr. F. Homes Dudden, Master of Pembroke College, delivered on Oct. 5 his valedictory address as retiring vice-chancellor. In it, after paying tribute to the memory of the late Dr. G. Claridge Druce, of whom he spoke as the greatest English field botanist of his generation, he extended the welcome of the University to Prof. Plaskett, the new Savilian professor of astronomy. He announced that the extension of the Radcliffe Science Library would be taken in hand at once, though the additional space thus secured would at first be used to relieve congestion in the main Bodleian building. Among benefactions he mentioned the gift of £1000 from Prof. J. M. Baldwin for the capital endowment of the Edward Bagnall Poulton Fund ; and as recent interesting developments he enumerated the experimental establishment of a bureau for the prosecution of research on the ecology and population problems of wild animals, and the proposed establishment of an Institute of Ornithology to collect and co-ordinate information concerning the numbers, distribution, and habits of British birds.

ON November 4, at 8 P.M., Mr. H. Ramsbotham, Parliamentary Secretary to the Board of Education, will open the building extension of the Chelsea Polytechnic, Manresa Road, London, S.W.3, and distribute diplomas and certificates to students.

THE Trustees under the will of the late Viscount Leverhulme have instituted a number of post-graduate studentships in chemical engineering. These studentships, which are of the annual value of £250 each, are tenable at the Ramsay Memorial Laboratory of Chemical Engineering, University College, London. They are open to graduates in chemistry or engineering who also have an adequate acquaintance, gained by employment or otherwise, with factory or business conditions. The holders of the studentships may, at the discretion of the Ramsay professor of chemical engineering, either follow the ordinary course of study, leading to the College diploma in chemical engineering, or a special course of study in that subject, or carry out original research work. It is particularly appropriate that these studentships should be associated with the memory of Lord Leverhulme, since chemical engineering research and practice have always played a very large part in promoting the development and success of the great industrial organisation which he founded. Two studentships are to be awarded immediately. Applications for these should be addressed to the Secretary, University College, Gower Street, London, W.C.1.

THE London County Council's programme of lectures and classes for teachers includes under the headings of Science and Domestic and Health Subjects items which should enable teachers to make good some of the alleged deficiencies in present practice. A course of lectures and demonstrations by Mr. F. J. Pearson at the Institute of Education in "General Science for Senior Pupils", will direct attention to the advantage of framing science syllabuses on a wider basis than that traditionally employed. Courses of lecture-demonstrations by Prof. J. R. Partington at East London College, in "The Chemistry of Daily Life", and by Prof. Chas. R. Darling at the Borough Polytechnic, in "Physical Science in the Modern Home", will illustrate the application of the principles of science and scientific knowledge to vocational and other useful purposes, and link up work in the laboratory with work in the kitchen. Biology presents special difficulties as a practical school subject, especially in urban schools. Assistance in overcoming them will be the aim of a course of ten lectures by Miss von Wyss, beginning next January, at the Institute of Education. Food and dietetics will be dealt with in a course of lectures by Prof. Winifred Cullis, beginning in February.

RURAL schools in the United States of America have for many years presented peculiar problems of great difficulty and importance. Their importance is apparent in view of the fact that schools in rural districts (population under 2500) have an enrolment of nearly eleven million children and are staffed by four hundred thousand teachers. As schools have to a large extent been administered as a local district affair, and as wealth has been largely concentrated in urban districts, the schools in the rural districts have suffered from lack of financial support comparable with that enjoyed by city schools. The backward condition of large numbers of them has been known in a general way, but few research agencies have interested them-

selves in this field. A notable contribution to knowledge of the subject has been published by the United States Office of Education in the form of a pamphlet (*Bulletin* No. 3 of 1932), entitled "Status of Teachers and Principals Employed in the Rural Schools". Within rather wide limits, school boards of most rural communities still hire whom they please, agree among themselves concerning professional standards, and bargain with the candidates for the lowest possible salary rates. It appears that the average annual stipend is 926 dollars. Nearly forty per cent of the entire number of teachers are employed in one-room schools. Nearly one-fourth of this group are twenty years of age or younger, and about four per cent are not more than eighteen. The most extreme status problem, the report says, is presented by the negro teachers of one-room schools, upwards of eighteen thousand in number, who receive, on an average, only 314 dollars a year, and have received an education equal to only about 2½ years above the elementary school standard.

Calendar of Geographical Exploration

Oct. 19, 1920.—Flora and Rivers of South-East Asia

F. Kingdon Ward reached the Tra-mu-tang and the marble gorge of the Salween, just above which the glacier-fed torrent from the Gomba La enters. The torrent was followed to the Salween-Irrawaddy divide. On this journey Kingdon Ward verified the conclusion that the Mekong-Salween divide up to the 28th parallel forms roughly the boundary between a Chinese flora to the east and an Indo-Malayan to the west. He also made some observations on the deglaciation and morphology of the region. Kingdon Ward has continued his explorations in the mountain masses of south-west China and its borders and has combined botanical work with geographical discovery.

Oct. 21, 1883.—Greely in the Arctic

Lieut. A. W. Greely and his party were obliged to winter at Cape Sabine, their third winter without supplies. A few depots were found which had been left by Sir George Nares and W. M. Beebe, but all stores were exhausted before the spring. When the sun reappeared in 1884, some of the party died of starvation and the relieving steamers did not reach Cape Sabine until June 22. Greely and his party were found almost at the point of death, but with their scientific instruments in order and with their great collections of specimens intact. Greely's party had been conveyed to Lady Franklin Bay in 1881 as the American contingent of the series of circumpolar stations arranged for at an international polar conference held in Hamburg in 1879. A relief ship should have reached the party in 1881, but failed to do so until 1884, with lamentable consequences for the unfortunate party, which in spite of great misery and suffering, heroically continued its scientific work during the whole of the period. Much geographical survey work was carried out, especially in Grinnell Land and along the north coast of Greenland.

Oct. 21, 1928.—The Alai-Pamir Expedition

The Alai-Pamir expedition returned to Osh, whence it had started on June 19. It was a joint expedition organised by the Notgemeinschaft der Deutschen Wissenschaft in Berlin and the U.S.S.R. Academy of Sciences in Leningrad, in charge of W. Rickmers Rickmers, who had in 1913 conducted an expedition in the same region. The results of this work are not yet published in full, but much new topographical detail is already available. The scientific staff of the expedition collected much meteorological, ethnological and biological data.

Societies and Academies

Paris

Academy of Sciences, Sept. 5 (vol. 195, pp. 505–524).—L. Mangin: Notice on Roland Thaxter.—Gr. C. Moisil: The sudden breaks of probability in stochastic evolutions.—Jean Mirguet: The paratingent of a point ensemble.—Benjamin Meisel: A property of the strain in a plane problem of the theory of elasticity.—P. F. Papcovitch: The general solution of the fundamental differential equations of elasticity, expressed by three harmonic functions.—Léon Auger: The movements of pulsating reeds in organ pipes. An experimental study of the movements of the tongue of a vibrating reed, recorded photographically, with varying wind pressure.—René Hardy and Bertrand-Lepaute: A direct reading stroboscopic radio-compass.—A. da Silveira: The Raman effect in saline solutions.—C. Gaudefroy: Correction and addition to the description of equiline and folliculine.

Geneva

Society of Physics and Natural History, July 7.—E. Cherbuliez and Fr. Meyer: New researches on the fractionation of casein. According to recent results, casein contains at least two different constituents, one called α, insoluble in dilute ammonium chloride, whilst the other, β, is soluble in this solvent. The authors have proved that the β part itself consists of at least two substances, one precipitable in the saline solution at $pH = 3 \cdot 6$ and constituting the greater part of the soluble fraction (γ), the other remaining in solution under these conditions and precipitable by acetone (δ). The proportions by weight of the three fractions in the casein have been approximately determined: α, 65–70 per cent; γ, about 30 per cent; δ, 2 per cent. Moreover, these proportions appear to be variable. The three constituents have been also characterised by their percentage composition, especially by differences in sulphur and phosphorus, and their varying proportion of tryptophane.—E. Cherbuliez and Mme. J. Stephani-Cherbuliez. The influence of the intramuscular introduction of oil on the proportion of lipases in the blood serum. As the result of work on antituberculous chemitherapy by means of oil solutions of compounds of copper, the authors have taken up the old problem of the influence of the introduction of foreign fats on the lipolytic power of the organism. In tests made on man, extending over several weeks, they have proved that intramuscular injections of olive oil and of solutions of drugs in this oil do not appreciably modify the proportion of lipases in the serum. Further work should show if the lipolytic powers, especially the leucocytes, undergo modification in the course of the treatments indicated.—W. Bader: The synthesis in two stages of acetic acid from water gas. Methanol is first prepared using vitreous oxide or sulphide catalysts, in which the spacing of the active points is not the same as in crystalline cata-

lysts. Then the methanol as methyl phosphate is combined with carbon monoxide at 300°–320°C. and under a pressure of 100–200 atmospheres. The catalyst is a cuprous-phosphoric complex dissolved in the acid. Only acetic acid and methyl acetate are formed in this reaction.—**A. A. Bron** and **E. Briner**: Researches on the catalytic dehydration of some phenols. The authors have dehydrated a certain number of phenols, and specify the action exerted by certain chemical groups on the tendency to dehydration.—**P. Bolle** and **E. Briner**: The chemical activity of nitric acid in solution. The results deduced from the study of reactions of nitration and of absorption of nitric oxide by nitric acid show that these reactions are due to the non-dissociated fraction of the nitric acid.—**E. Briner** and **H. Biedermann**: Peculiarities of the chemical reactivity of ozone in the absence of oxygen. By replacing oxygen by nitrogen as a diluent of ozone, it has been recognised that the oxidising power of ozone on benzaldehyde is reduced to one atom of fixed oxygen for each molecule of ozone consumed. —**A. J. Weigle** and **R. Luthi**: The abnormal dispersion of amyl alcohol for short wave-lengths. The dielectric constant of a solution of amyl alcohol in a very viscous oil (Shell *BL*3) has been measured at − 10°C. for waves varying between 334 and 2·8 metres wave-length. The dielectric constant diminishes since the dipoles of amyl alcohol no longer take up a definite position in the electric field. Moreover, this decrease does not correspond with that predicted by the Debye theory. These experiments give interesting information on the structure of liquids.—**J. Weigle** and **H. Saini**: A new apparatus for the exact determination of the dimensions of crystalline networks. An apparatus based on the Seemann-Bohlin principle has been constructed by the authors. Making use of interferences of high order, the crystal dimensions can be measured with an accuracy of about 1 in 100,000. This apparatus can be used for the determination of coefficients of thermal expansion of crystal networks.—**W. H. Schopfer**: The supposed vitamin action of some amines. The author's experiments, made with histamine, tyramine, glucosamine, hordenine, betaine, choline, ethylamine and ethylenediamine show that it is impossible to attribute the slightest vitamin action to these substances.

Rome

Royal National Academy of the Lincei, April 17.—**L. Cambi** and **L. Szegö**: Sulpho-salts of copper and iron. In its magnetic behaviour, the sulpho-salt $KFeS_2$ approximates to pyrites, ferrous sulphide, and many complex ferrous salts, whereas the sulpho-salts $K_mFeCu_nS_p$ recall, on one hand, pyrrhotine, and, on the other, those ferric sulpho-salts in which the iron present is assumed to have the structure of the ferric ion. The tendency to assume states approaching the diamagnetic state at low temperatures is observed with the paramagnetic sulpho-salts of iron. The sulpho-salts now under consideration are diamagnetic, as also are the copper sulphides.—**Enea Bortolotti**: Deformations of higher species and systems of forms for a V_m in R_n.—**E. Gugino**: The geodetic curvature of the lines of a Riemannian space of *n* dimensions. —**U. Broggi**: A generalisation of the developments in series of determinant functions.—**Maria Cibrario**: The reduction to canonical form of the linear equations to the partial derivatives of the second order of mixed type.—**T. Viola**: Functions of continuous limited variation towards the right.—**A. Masotti**: A theorem of unicity relating to Poisson's equation. —**M. Zeuli**: A generalisation of the centre of the osculatrix sphere.—**N. Cioranescu**: The determination of a harmonic function by the initial global conditions. —**Ruy Luis Gomes**: The limits of the normal derivative of a simple layer potential.—**G. Colonnetti**: Influence of the shearing force on the deflection of a beam. (2) Further proof of the fact that the shearing force influences the deflection of an inflected beam is obtained by consideration of the case of a lattice girder with parallel top and bottom members.—**F. Conforto**: Impulses in isotropic elastic bodies.—**D. Graffi**: Adiabatic invariants as a method of approximate integration of differential equations.—**G. Krall**: Distant limits of the motion of a planetary system.—**U. Barbieri**: Astronomico-geodetic station on Bric Torniola, July 1928.—**G. Viola**: The periodicity of the mean annual temperature in relation to that of sunspots. For Naples, Rome, and Gaeta, the period of variability of the mean temperature is about one-half of the frequency period of sunspots. These results are at variance with those of Köppen, according to whom the mean temperature curve exhibits a course opposite to that of the sunspot curve.—**Joan Y. Placinteanu**: The equilibrium between matter and radiant energy. In studying the radiation of the stars, Eddington advanced the hypothesis that this radiation is always accompanied by variation in the total mass of the star, the atoms of matter undergoing transformation into particles of radiant energy, and Stern deduced a formula for calculating, for the case of thermodynamic equilibrium, the number of particles per c.c. The author now considers the conditions when photons are present and shows that Stern's formula does not then apply.—**D. Bocciarelli**: Radioactivity of potassium. Occhialini's method of magnetic analysis, devised for studying the β-radiation of rubidium, has been used for investigating the still feebler radioactivity of potassium.—**T. Carpanese**: Granite, vesuvian, ilmenite, and titanite from Monte Rosso di Verra (Monte Rosa group).

Sydney

Linnean Society of New South Wales, May 25.—**H. J. Carter**: New Guinea and Australian Coleoptera. The paper contains descriptions of twenty-two species as new, in the families Georyssidæ (1 species), Buprestidæ (4), Tenebrionidæ (9), Cistelidæ (3), and Cerambycidæ (5).—**J. G. Churchward**: Inheritance of resistance to bunt, *Tilletia tritici* (Bjerk.) Winter, and other characters in certain crosses of 'Florence' wheat. 'Florence' was crossed with four susceptible commercial Australian varieties of wheat, each cross giving a similar result. A graph representing distribution of F_3 families in 5 per cent classes for bunt infection shows a trimodal curve indicating a single factor difference for bunt resistance. Experimental results of the crosses are given, and also results of observations on the occurrence of grass clumps and the inheritance of chaff colour.—**G. A. Currie**: Some notes on the biology and morphology of the immature stages of *Harpobittacus tillyardi*. The larvæ and pupæ of *Harpobittacus tillyardi* E.P. are described for the first time. Notes on the biology of the insect are given and, as the larvæ of Australian Bittacidæ have hitherto been unknown, their feeding and other habits are described.

Royal Society of New South Wales, June 1.—**W. H. Love**: The mitotic activity of normal and malignant tissues and its modification by X-rays. This study is made from the biological, physical, and mathematical points of view. A theory of the occurrence of mitosis in normal tissue cultures (fibroblasts), and in Jensen's rat sarcoma, is developed and applied to several aspects of the problem of cell division. The quantita-

tive modifications produced by X-rays in the mitotic activity of these tissues are then studied experimentally and analytically. Within certain limits, the experimental results are in good agreement with the predictions of analysis. Outside these limits there is, in some experiments, a marked divergence between the two. The significance of this divergence is considered, and an explanation, supported by experimental evidence that seems conclusive, is advanced.—J. C. Earl and N. F. Hall: The chemical changes involved in the formation of aminoazo-compounds (1). By examining the volume-temperature curves of methanol solutions containing amine hydrochlorides and sodium nitrite, an indication has been obtained of an intramolecular rearrangement of amine nitrite to an intermediate compound prior to the formation of diazocompound or nitrosamine. When the solution is kept neutral by employing equimolecular proportions of amine hydrochloride and sodium nitrite, the change does not take place, nor, in the case of aniline, does the solution show any coupling with alkaline β-naphthol. Addition of a small quantity of acid to such a mixture brings about the formation of diazocompound as shown by the coupling reaction with β-naphthol (*cf.* Wallach, *Annalen*, **257**, 319).—Thelma M. Reynolds: Note on the action of titanium tetrachloride on tetracetyl-β-*d*-glucosido-glycollic ester. Tetracetyl-β-*d*-glucosido-glycollic ester (Fischer and Helferich, *Annalen*, **383**, 81; 1911) reacts with titanium tetrachloride in the same manner as the fully acetylated sugars (Pacsu, *Ber.*, **61**, 1508; 1928) giving acetochloroglucose, whereas the β-glucosides previously studied (Pacsu, *loc. cit.*; *J. Amer. Chem. Soc.*, **52**, 2563; 1930) were rearranged into the corresponding α-glucosides.

Forthcoming Events

MONDAY, Oct. 17

King's College, London.—Prof. Claude F. A. Schaeffer: "The Excavations at Ras Shamra in Syria—the Results of the Four First Expeditions, 1929–32", at 5.30 (succeeding lectures on Oct. 20 and 21).

London School of Hygiene and Tropical Medicine (Heath Clark Lectures).—Prof. Carl Prausnitz: "The Teaching of Preventive Medicine in Europe", at 5 p.m. (succeeding lectures on Oct. 18, 19, 20 and 21).

TUESDAY, Oct. 18

Eugenics Society—(at the rooms of the Linnean Society, Burlington House, Piccadilly, W.1).—Dame Helen Gwynne-Vaughan: "The Contribution of Plants to the Study of Heredity", at 5.30 p.m.

Hackney and New College, London—(Drew Lecture at the Memorial Hall, Farringdon Street).—Prof. John Macmurray: "The Conservation of Personality."

Imperial College of Science and Technology.—Air Commodore J. A. Chamier: "Air Power", at 5.30 p.m. (succeding lectures on Oct. 25, Nov. 1, 8, 15 and 22).

University of Leeds.—Prof. John Garstang: "Further Discoveries at Jericho", at 8 p.m.

Royal College of Physicians—(Harveian Oration).—Sir George Newman, at 4 p.m.

WEDNESDAY, Oct. 19

Folk-Lore Society—(at University College, Gower Street, W.C.1).—Mr. Bertram Thomas: "Arab Folk Stories Heard in the Rub' al Khali", at 8 p.m.

THURSDAY, Oct. 20

Bedford College for Women—(Fawcett Lecture).—Dr. C. R. Fay: "Women as Wage-earners and the Significance thereof in the Development of Economic Theory", at 5.15 p.m.

Chadwick Public Lecture—(at the Royal United Services Institution, Whitehall).—Sir Humphry Rolleston, Bart.: "The Pioneers and Progress of Preventive Medicine", at 5.15 p.m.

Child Study Society, London—(Cockburn Memorial Lecture).—Dr. P. B. Ballard: "Thirty Years' Progress in London Education", at 6 p.m.

Institution of Electrical Engineers—(Inaugural Address).—Prof. E. W. Marchant, at 6 p.m.

FRIDAY, Oct. 21

North East Coast Institution of Engineers and Shipbuilders—(Annual General Meeting).—Mr. R. J. Walker (Presidential Address).

Official Publications Received

British

Colony and Protectorate of Nigeria. Annual Report on the Geological Survey for the Year 1931. Pp. ii+40+4 maps. (Lagos: C.M.S. Bookshop; London: The Crown Agents for the Colonies.) 2*s.* 6*d.* net.

Ordnance Survey. Re-Levelling of London, commenced January, 1931. Abstracts of Secondary Lines (giving Values in Advance of publication, on the Newlyn Datum, for use with existing Large Scale Maps.) By Brigadier H. St. J. L. Winterbotham. Pp. 51+1 plate. (Southampton: Ordnance Survey Office.) Paper, 7*s.* 6*d.* net; cloth, 8*s.* 6*d.* net.

Battersea Polytechnic. Calendar of Evening and Afternoon Courses and Classes for Session 1932–33. Pp. 31. Free. Technical College for Day Students and Day School of Art and Crafts. Calendar, Session 1932–33. Pp. 50. 3*d.* Domestic Science Department and Training College. Full-time Day Instruction, Afternoon and Evening Classes, Session 1932–33. Pp. 32+1 plate. 3*d.* Department of Hygiene and Public Health. Session 1932–1933. Pp. 23. 3*d.* (London.)

The Quarterly Journal of the Geological Society of London. Vol. 88, Part 3, No. 351, August 29th. Pp. 311–515+plates 19–30+cxxv. (London: Longmans, Green and Co., Ltd.) 7*s.* 6*d.*

The Year's Work in Librarianship. Vol. 4, 1931. Edited for the Library Association by Arundell Esdaile. Pp. vii+296+4 plates. (London: The Library Association.) 7*s.* 6*d.* net; to Members, 5*s.* net.

East London College (University of London.) Calendar, Session 1932–1933. Pp. 211. (London.) 1*s.*

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Vincent, for the Year 1931. Pp. vi+32. (Trinidad.) 6*d.*

Papers and Proceedings of the Royal Society of Tasmania for the Year 1931. Pp. iv+136+19 plates. (Hobart: Tasmanian Museum.) 10*s.*

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Lucia, 1931. Pp. iv+48. (Trinidad.) 6*d.*

University of London: University College. Faculty of Medical Sciences, University Centre for Preliminary and Intermediate Medical Studies. Courses for Dental Students, Session 1932–1933. Pp. vi+269–304+12. (London.)

Foreign

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 373–375: Hyperfine Structure of Mercury Spectrum, VI, by K. Murakawa; Hyperfine Structure of Arc and Spark Spectra of Barium, by K. Murakawa; Diffraction of Cathode Rays by Single Crystals, Part 2: Mean Inner Potentials of some Crystals, by K. Shinohara. Pp. 299–322+plates 11–13. 85 sen. No. 376: Über Rotenon, den Wirksamen Bestandteil der Derriswurzel, Mitteilung I–XIII. Von S. Takei, S. Miyajima und M. Ono. Pp. 26. 20 sen. (Tokyo: Iwanami Shoten.)

University of Chicago. Publications of the Yerkes Observatory, Vol. 7, Part 2: A Study of the Spectrum of 7*s* Aurigæ. By Edwin B. Frost, Otto Struve and C. T. Elvey. Pp. vi+52+3 plates. (Chicago: University of Chicago Press; London: Cambridge University Press.) 8*s.* 6*d.* net.

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil. Vol. 7, No. 2. Rédigé par E. S. Russell. Pp. 171–336. (Copenhague: Andr. Fred. Høst et fils.)

Museums of the Brooklyn Institute of Arts and Sciences. Report upon the Condition and Progress of the Museums for the Year ending 31st December, 1931. By William Henry Fox. Pp. 86+4 plates. (Brooklyn, N.Y.)

Field Museum of Natural History. Zoological Series, Vol. 18, No. 10: Mammals of the Kelley-Roosevelts and Delacour Asiatic Expeditions. By Wilfred H. Osgood. (Publication 312.) Pp. 191–339+plates 9–11. (Chicago.) 75 cents.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 80: Studies on the Sounds emitted by Revolving Airscrews. Part 2: Experiments with Model Airscrews. By Jûichi Obata, Yakei Yosida and Sakae Morita. Pp. 389–440. 0.67 yen. No. 81: On Hollow Spindle-shaped Liquid Jet. By Kyôzi Itô. Pp. 441–467+8 plates. 0.50 yen. (Tôkyô: Kôseikai Publishing House.)

Proceedings of the United States National Museum. Vol. 80, Art. 21: Insects of the Order Orthoptera of the Pinchot Expedition of 1929. By A. N. Caudell. (No. 2921.) Pp. 7. (Washington, D.C.: Government Printing Office.)

Proceedings of the Imperial Academy. Vol. 8, No. 7, July. Pp. xix–xx+275–329. (Tokyo.)

SATURDAY, OCTOBER 22, 1932

CONTENTS

SUPPLEMENT

Practical Policies for the Countryside

INTEREST in the countryside for its own sake is penetrating into the life of the people more rapidly and more extensively than it has for two hundred years. Few would wish to range themselves, nowadays, with that eighteenth century parson of Elsdon in Northumberland who reported that the summer-time moors around him were covered by the purple flower of a plant called ling, which made the landscape "indescribably hideous"; and fewer still, as Prof. G. M. Trevelyan reminded us in his Rickman Godlee lecture, would agree with General Wade's civil adviser when he described the bare tops of the Scottish Highlands as producing "the disagreeable appearance of a scabbed head" and the hill-masses themselves as presenting no more than "stupendous bulk, frightful irregularity, and horrid gloom". The revived use of the highway, facilities for rapid transit, encouragement of walking, the resurrection of the foot bicycle, are at once the expression and in part the cause of this new appreciation of Nature. In the Northern Highlands this summer we have wondered at the full bus-loads of townsmen from Glasgow, Blackpool, London and elsewhere making the grand tour to John o' Groats and back: the choice of such a holiday is significant, the experience must be adding to the multitude of those who treasure memories of Nature's grandeur and beauty.

Clearly, then, there is a vast and increasing body of opinion in Great Britain, and that not confined to one or other of the artificial classes of the people, which is interested in the beauty of the countryside, and would resent interference with the amenities from which pleasure and inspiration are derived. Yet there can be nothing more certain than that in many places amenities are threatened and in others are rapidly disappearing. Industry lifts its smoking chimneys, or disfigures waterfalls, or remodels lakes far from the populous haunts of men. The town spreads into the country; it "must expand and the suburb is a straggling compromise between town and country, ill-planned from the urban point of view and equally disregarding the landscape as such", as the president of the Council for the Preservation of Rural England put it. The townsman spreads himself over the countryside, and thrust by the new facilities for travel into a Garden of Eden where flowers flourish without the toil of cultivation and the stimulus of artificial manures, plucks

to his heart's content, blazing his mark upon the face of Nature as senseless louts scratch their initials upon monuments of antiquity.

Some of these interferences may be necessary, for no one would hold that the well-being of mankind is to wait upon, say, the preservation of the natural margin of a Highland loch; but some are unnecessary in their present aggravated form, and yet they take place in spite of that vast body of public opinion to which we have referred. The reason is that for the most part the public sense of amenity is little more than a hazy goodwill, indefinite, unorganised, without a clear objective, unaware of a means of carrying out what it feels to be desirable. It receives a certain amount of expression through the activities of societies such as the Councils for the Preservation of Rural England and Scotland, the Society for the Promotion of Nature Reserves, the Commons, Open Spaces and Footpaths Preservation Society, the Road Beautifying Association, the Green Cross Society, the Men of the Trees, the Royal Society for the Protection of Birds, and so on; their very number and variety indicate the scattered forces behind them. But even these bodies, representing the enthusiasts, fail to reach and collect the mass of ordinary opinion altogether or almost ready to support their endeavours. What the countryside needs is the organisation of the hazy goodwill which so far, if it reaches the level of expression at all, finds expression only in subdued grumblings and in occasional outbursts in the daily Press.

The need has been foreseen and a way has now been pointed for the concentration of effort on behalf of the amenities, of landscape, of flora and of fauna. A year ago the Committee of the Corresponding Societies of the British Association for the Advancement of Science recommended the Council of the Association to instruct the president of the Conference of Delegates to direct attention to "the assistance local societies can render to the preservation of the amenities of their own areas and especially of the flora and fauna of the countryside". The president was Sir David Prain, and the sympathy and good wishes of the scientific world will be with him in the illness which unfortunately prevented him from delivering his address in person. But the address has been printed and, as becomes the product of Prain's nationality and boreal University, it is a dry, direct, practical document, a guide to practical policies in the countryside which ought to focus vague hopes and therefore ought to be the constant companion of those country lovers who believe in getting things done.

There is a fundamental divergence of interest between the dweller in towns and the countryman, and to this Sir David Prain traces the inroads upon wild Nature which have been so marked in our land since the industrial revolution. Directly, it has destroyed "the amenities and the flora and fauna of the countryside by creating clouds of smoke that obscure the sun, discharging acrid fumes that vitiate the air, emitting fetid waste that pollutes our streams, and heaping mine tailings on what was once fertile soil". It was the scientific worker, by the way, who brought partial relief from these evils by convincing captains of industry that costs could be reduced if smoke were consumed, and profits could be increased by the utilisation of waste products.

Indirectly, the influence of industry crept still further into the heart of the country. Industry drew a proportion of the rural population to the towns, and having chained it there demanded that the depleted countryside should furnish more and more food to meet the needs of town workers, who no longer raised food for themselves. For a time town and country became linked in a common interest; agriculture, knowing that it had the solid support of the towns, cultivated the wastes, often at great capital outlay, it intensified its methods of husbandry, planted shelter belts of trees and larger woodlands; and the town on its side encouraged the building of highways along which agricultural produce reached the towns and manufactured goods the country. But the fundamental antagonism was hidden and not eradicated, for "the moment English industry found it possible to obtain supplies of food from other sources, English urban sympathy with English rural interests vanished like a morning mist". That may be true of the commercial side of urban life, but it surely fails to give due weight to the great body of townsmen who appreciate the open country, sometimes with fresher vision and deeper feeling than the countryman himself, and whose support is the mainstay of the associations created for the preservation of its amenities.

Whatever may be the relationship between town and country, it is certain that at the moment the latter requires all the forces it can muster on its behalf. Sir David Prain points to the local societies as the proper bodies for the effective organisation of goodwill towards the countryside and its wild inhabitants. They must sound, and

if need be create, local feeling to meet the threats of unnecessary encroachment. They must work hand in glove with the local authorities, supporting and forwarding their schemes if they are good, offering better suggestions, in place of sterile opposition, if they are unsatisfactory. They must make themselves familiar with the technique of saving and preserving landscape, flora and fauna; and to this technique a great part, the most practically useful part, of the address is devoted.

We take it that the address will be used as a handy guide to the preservation of Nature in Great Britain, so that there is no need to discuss its recommendations in detail; but a few samples of Sir David Prain's advice will show how directly he is driving at the mark. If the threat be to the general amenities of the area or to some special view-point or beauty spot, a local society can scarcely fail to benefit by the experienced advice of the Council for the Preservation of Rural England or of the executive committee of the National Trust for Places of Historic Interest or Natural Beauty. Experience shows that the only safe course in most cases is to purchase outright and render inalienable the threatened spot. But a local society should hesitate to burden itself with the possession and care of such a property; it may raise funds for purchase, create an endowment for future maintenance, but as a rule its final step must be to request a permanent, legally constituted body such as the National Trust to accept the property. This course premises that before any steps have been taken the local society will have consulted the Council of the National Trust as to the suitability and desirability of preserving the particular place of interest and that, therefore, it will have the moral support of that body in its appeal for funds.

A difficulty arises, however, if the objects to be preserved are not places of beauty or general amenity, but particular representatives of the flora or fauna; for "absolute protection of wild life in properties acquired to safeguard amenities is not easily provided: properties acquired to safeguard amenities must remain accessible to the public they benefit". Sir David Prain is of opinion, and many agree with him, that the rarities of fauna and flora can be retained for posterity only by the exclusion of the people. This calls for the creation of a special Nature reserve or sanctuary, and so for a different method of treatment. "A sanctuary need not be 'a place of natural beauty'; even if it be, in fact, entitled to be so regarded, the National Trust may be debarred from accepting the burden of ownership, because a sanctuary becomes valueless unless access to it is denied." In such case the local society interested would approach for advice and support the Society for the Promotion of Nature Reserves, a body empowered by charter to own sanctuaries of the kind, which, largely in view of the attitude of 'collectors', require much more strict patrolling, and therefore a larger endowment for upkeep, than simple beauty spots.

Sometimes local societies will find that "the agencies inimical to wild life in their own areas have become so powerful that the establishment of a 'sanctuary' is impracticable, and that the only means of conserving the wild life once characteristic of the neighbourhood is to acquire a suitable site and convert this into an 'asylum', for such plants, insects and birds, known to have been at one time native there, as can be placed in or attracted to the 'asylum'." Such an asylum must be as freely open to the public as "a place of natural beauty", but the difficulties arise that while its accessibility to the public should prevent the Society for the Promotion of Nature Reserves from accepting ownership, its artificial origin should preclude the National Trust from doing so. Here again the local society will find its course indicated; upon it must fall the burden of raising funds for establishment and maintenance, but this done there should be no difficulty in obtaining the consent of the local authorities to accept the responsibility of ownership.

These are high ideals, difficult of attainment, which are held up for the consideration of the local societies; but the very fact of their formulation may suggest a definite direction for activities hitherto dispersed in less important ways. The path will not be easy: "Local societies may anticipate many difficulties and much opposition, some of it due to self-interested motives, but more of it due to misunderstanding. That need not discourage them, provided they are on good terms with and enjoy the sympathy of their own local authorities. With that behind them, local societies can do much." Every likely problem Sir David Prain has passed under review and accounted for, and it will be a fitting crown to his labours in this field that in the years to come places of natural beauty will be preserved, and Nature reserves and asylums for the conservation of local wild life will spring into being through the organised efforts of local societies following his wise guidance. J.R.

Geographical Study of Society and World Problems*

By Prof. H. J. FLEURE

IT has been assumed in many discussions that mass-production and commerce on a large scale represent a new mode of life, a form of society, that is conquering the world and must disintegrate older modes of social life and organisation. However true this is, there are limitations, obvious now that production far beyond immediate selling possibilities is causing so much difficulty. It is truer to say that various types of society are trying to graft on to their ancient heritage this new scheme of mass-production.

It may have been useful, up to a point, to think out the increase of production through specialisation as Adam Smith does in his famous argument about pins, but there was need for far more thought than seems to have been given to the maintenance and development of social life in the various environments Nature provides and man adjusts. Social forms result from interaction between men and their environments, and the lessons learned and the ideas selected and developed in different cases have been very different. This is a legitimate and important sphere of work for the student of geography. In each case, the people and their form of society are so much a part of the other that, whatever changes mass-production may bring, they want to, they must in fact, keep a large measure of continuity from their past.

They have nearly all once been, in the main, self-contained groups, or, at least, external commerce has been subordinate to internal exchange. The idea of the self-contained unit is thus very deep-rooted. With great effort the village has come to feel itself part of the nation, which has clamoured for opportunities of self-expression. Many a nation naturally, therefore, seeks to be self-contained, all the more if it feels that specialisation and consequent dependence on imports is going to give it an inferior position.

HUNTING GROUPS

We may distinguish at least three main phases of expansion of hunting cultures, possibly all associated with *Homo sapiens*, from an Arabian-African zone, while another culture has its origins and associations still doubtful. The interest of these ancient cultures here is that the two or three later stages among them occur mingled in South Africa, apparently also in India, and among the Australian natives. In fact, if we use as a hypothesis the idea of drifts from northern Africa and south-western Asia, we have a key to some modern distributions of hunting peoples. These societies are either in what are ultimate corners or in areas of special difficulty; elsewhere they have been superseded by agriculturists. The pygmies of the equatorial forest of Africa are remnants in a region of hot, wet climate where debilitation makes achievement difficult. The Bushmen of south-western Africa are in a region of sheer poverty in a far corner. The Veddah and some jungle tribes of southern India are in another far corner under conditions that forest or jungle makes difficult. The Australians and recently extinct Tasmanians are in a far corner, isolated by orographical changes. The pygmies and some other hunting groups of Malaya and the East Indies and Philippines are, again, in what are almost ultimate corners, isolated by land-sinking, and also in regions of warm, wet forest.

AGRICULTURAL PEOPLES

The post-glacial intensification of the desert in northern Africa and south-western Asia caused pressure of population on the Nile and Euphrates and possibly the Indus as well, all rivers with regular floods running through dry or then fairly dry open country with a warm season. In or near these river valleys there arose the art of cultivation. All these rivers permitted and encouraged irrigation, and the deposit of silt from floods gives a renewal of fertility, so exhaustion of the soil was not a problem of early cultivators near the rivers. The courses of the Euphrates and Indus were conspicuously subject to variation, whereas the Nile is confined in its famous slot and its peasantry has gone on from time immemorial until near our own day with a remarkable measure of constancy as regards the economic basis of life.

Domestication of animals was an achievement of very early times too, and, in such regions as the Fertile Crescent with its grass zones, it undoubtedly assumed great importance and led to the beginning of age-long conflicts and interactions between herdsmen and cultivators. The herdsmen, basically a close corporation gathering around the flocks and needing men to add to their strength for defence, as well as discipline and organisation to maintain unity, have often dominated peasant neighbours; but this special ability appears to have been much developed when the horse was acquired as a companion and helper.

The bearings of the introduction of cultivation on social life and organisation have obviously been of the first importance. There was an observable sequence that made argument more solid than it was likely to be in the days of hunting when accidental coincidences loomed larger. The habit of prevision extended itself through calculations of the coming of the floods and correlated study of the heavenly bodies to the framing of a calendar. There was a further extension of prevision beyond that to a succession of years—namely, to a succession of generations specially associated with the domestication of animals and with the family.

Thought, drawn out towards the future, seems just as naturally to have run back into the past,

* From the presidential address to Section E (Geography) of the British Association, delivered at York on Sept. 1.

giving rise to genealogies which are one of the germs of history and also to rites of reverence paid to ancestors. These rites, not unnaturally, are specially marked in regions such as China which owe so much of their civilisation to early interactions of herdsmen and cultivators on the ways from central Asia. It is of interest to note that the large household, linked by real or sometimes assumed blood relationship, seems a social feature of basic character among the cultivators of northern China, and in other forms is notable among other cultivators around the edges of the great steppe, the famous Zadruga of parts of the Balkan peninsula being a case in point in a region in which interactions between herdsmen and cultivators have been and still remain most important features of life. The Russian Mir sometimes had a like origin. It is naturally a social development in large measure antagonistic to the growth of nationalism.

Along with the primarily psychical development accompanying the rise of cultivation went the linking of society with a definite piece of land through the establishment of the settled life. This association is one of the most important features of settled society, and leads to the idea that the living hold a trust from their forefathers and will pass it on to future generations.

Whatever may be found hereafter concerning the phases through which the early cultivating societies developed in their primary homes, there is little doubt that the spread of their scheme of life occurred in most directions in two stages. The first went with the hoe, used chiefly by women, and with domestic animals for food or milk, but not for work, and the second with the plough drawn by domestic animals under male control.

The first of these two rather artificially contrasted stages is the one that spread into intertropical Africa. There were special difficulties here. First the climate made steady prolonged efficient exertion difficult in many areas. Then the fundamental crops, wheat and barley, would not thrive in most parts, and inferior grains and other plants became the important crops. Further, there were practically no wild plants in intertropical Africa that the native cultivator contrived to domesticate; so progress depended largely on plants deliberately introduced, as for example via Egypt or by Arabs, Portuguese, etc., in later times. The introduction of maize, manioc, etc., from America has made a huge difference to Africa. Fly belts in several regions, also lack of salt and phosphorus deficiency, and no doubt climatic factors, limited the value of domestic animals in intertropical Africa.

Archæologists think agriculture spread into central Europe at first with the hoe and the non-permanent village that is a feature of parts of intertropical Africa; and there are indications of the same scheme in forested and therefore backward parts of central India and elsewhere in south-east Asia as well as in north Korea.

Agriculture with the plough has now ousted this scheme from Europe and most of Asia and, in this superior stage, the village becomes more permanent: either a rotation in the use of lands is established and the households have their strips in each of the village lands, or a portion of the village land specially enriched by manure from stock folded on it may be cultivated nearly every year, and some portion of an 'outfield' may be used as may be required or may be possible.

In the regions with irrigation or plough agriculture or both, the differentiation of crafts went much further than among societies with hoe cultivation. Exchange developed more considerably and there are towns or cities, fundamentally centres of exchange and of handicraft, and often of a priesthood and government. Cities are not found in inter-tropical Africa save in a few spots where they are due to intrusive influences of fairly recent date.

The nomadic or semi-nomadic societies of inter-tropical Africa live on their cattle, and by hunting and collecting, as well as by raiding those which are more sedentary and less ready for war. The nomadic and semi-nomadic societies of Europe, Asia and northern Africa have in many cases the important auxiliary activity of trade, and use their beasts as carriers. Moreover, they have typically developed or contributed to the development of stations, which have in many cases become centres of trade and religion, that is, sacred cities, near the bounds of the waste or in oases. In China, India and the Fertile Crescent the semi-nomad, especially after he acquired the use of the horse, found it possible to dominate the cultivator, and seems often to have contributed an elaboration of organisation to the group of social units; villages and their focal towns become grouped into larger entities.

Consciousness of Kind

In west, north-west and parts of central Europe, early development was slow because the food plants and animal breeds had to be acclimatised, and the problem of soil exhaustion was serious even if mitigated where the subsoil was of loess or related material. Nevertheless, there can be no doubt that settled populations in central and western Europe practising agriculture and living in villages were much more numerous in far pre-Roman times than it was customary to think a generation ago.

The spread of Islam in the Mediterranean region cut old trade routes for a time, and this increased the poverty following the decline of the Roman Empire, so that towns and cities went through a bad time, but apparently in several areas there was a marked increase of rural settlement.

As a hierarchy of social units re-established itself, growing mainly from local roots instead of from an external influence such as that of Rome, it is natural that such hierarchies should spring up where there was mutual comprehension of language in groups of villages and their focal market towns,

and cathedral cities in France. Moreover, charters and grants and agreements written in the vernacular came to be increasingly important, while the use of the vernacular in courts of first instance developed folk-speech. It is apparently a combination of all these factors that has maintained the distribution of the peasant languages of Europe without any change of great importance since the Middle Ages.

The idea of the city can be traced eastwards and northwards from France and the Rhine in the early Middle Ages, and, in relation with this, often, at the present day, the life of a town connects it with regions farther west, while the peasant life round about knows nothing of this. The Renaissance, being essentially an urban movement, accentuated this, and we note the French leanings of part of the upper classes in Alsace contrasted with the Alemannic tradition of the peasantry, German aristocracy and Danish common folk in parts of Slesvig, German (including Yiddish) affiliations of towns in Poland as against Slavonic life among the peasantry, Polish affiliation of towns and the upper classes in East Poland as contrasted with Lithuanian (in the north) and Ruthenian (in Eastern Galicia) traditions of the peasantry.

Traditionalism and Individualism

The problem was greatly deepened by another sequence of development. The Renaissance, whatever else it may have done, was a potent factor of the rise and spread of individuality. After it, much larger numbers of men in Europe became less members of a traditionalist community and more definitely persons with ideas of their own to express.

In some parts, notably in France, these changes, and even great political convulsions, long left some basic facts of society untouched. The peasantry long remained attached to, almost worshippers of, their soil, even if in parts of the west and south of that country this is no longer the case. The peasant acquired more dignity, but the village remained an entity; men still often make it their main ambition to hand on an improved farm to their descendants. The town too is often still essentially the focus and market for its region, and it often still carries on a number of small industries for the benefit of its neighbourhood. Its bourgeois are peasants only slightly modified. The idea of maintenance, rather than that of expansion on an English, German or American scale, is strong in many minds and France, characteristically, makes external trade subordinate to internal production for use and exchange. The reasonable assurance of her wheat, root crop, potato, and, but for a few calamitous years, vine and apple harvests, thanks to sunshine, has contributed a great deal to this, and has helped the French people to modify into modern forms the age-old feeling of a trusteeship (of the sacred soil) handed along the generations.

Britain's harvests have long been less secure because of summer rains and coolness, and, in the eighteenth and early nineteenth centuries, there grew first a widespread maritime commerce, and then manufacturing industries—in fact, the Industrial Revolution.

The home population came to exceed by a great deal the numbers that could be kept busy supplying the needs of their fellow citizens. Britain's export trade came to be her mainstay. The contrast between French and British development was thus extreme and startling.

Industrialism spread from Britain to Germany and led to a parallel increase of population. The German effort also had its aim moulded politically by the desire to rise out of an old position of political inferiority and disunion. Further, the historic cities of Germany in several cases, such as Nürnberg, Frankfurt-am-Main, Köln, Leipzig, and so on, had their situations predetermined by major physical considerations, and must be important centres so long as Germany is a land of organised civilisation. This fact and the related one of the finding of coal near the zone of gradation from the hills to the northern plain, that is, a zone of cities, led to the development of modern industry in several cases in historic towns, whereas in England the greatest developments took place in what had previously been small places. Both national and municipal authorities in Germany, therefore, had a larger and more direct share in the directing of industrial growth than was the case in Britain.

If we think along these lines we see why, quite apart from wars and questions of external political ambition on one side or the other, it has come about that the French people have been gravely anxious. Here are two enormously increased units, Great Britain and Germany, both dependent on export trade, neither able to live with any reasonable standard for the great multitude mainly on the produce of its soil.

The spread of large-scale industrialism makes the problems still more serious. There are now several States that have populations exceeding what their soils can support unless science intervenes afresh; all therefore compete for an increasingly precarious export trade, all are in danger of finding groups of their people, with highly specialised machine-tending activities and corresponding inelasticity of mind, suddenly thrown out of employment and unable to adjust themselves to new lines of enterprise.

Meanwhile, nearly half mankind, in the monsoon lands of Asia apart from Japan, is being shaken out of its traditionalist schemes by contact with the west, and nationalist ideas are germinating in various ways alongside schemes of industrial development that borrow from the west to such an extent as to be a danger to indigenous society. Then the newer lands which have received the later overflow of modern Europe, and seemed likely to become producers of raw material for Europe, are also being forced along the same line of nationalist development. They have borrowed

freely from Europe (chiefly Great Britain and France) and more lately from America, and have consequently found themselves faced with the duty of finding large amounts of interest. This interest often is not by any means earned by the working of the schemes on which the money was spent. To meet this call for interest, exports must largely exceed imports, and so tariffs are introduced to keep down imports, and local industries are started.

On all sides, in the first great burst of mass-production, local boundaries seemed to have been swept away. It is probable that our social thoughts and plans will have to regain contact with mother earth, each group basing itself on its own soil, but evidently not in the old sense of a self-contained isolation. Interdependence of all on each is a new feature that will become increasingly important, and one of the geographer's tasks is to try to see both the roots of each society in its own soil, and its relations to others.

White Dwarf Stars*

IN this year's Halley Lecture, Prof. E. A. Milne presents us with a systematic account of white dwarf stars in theory and observation. There is no doubt that, in view of their peculiar physical properties and the excellent example they provide for a successful application of modern quantum mechanics, white dwarfs are among the most interesting of natural objects. But this interest arises, of course, not so much from the direct observations as from the derived density of the star and its theoretical interpretation. It is therefore very valuable, at least to the non-astrophysical scientific worker, to have the facts and theories about white dwarf stars reviewed in this systematic way.

Owing to the importance of the existence of matter of great density to general physical theory, it is important to appreciate how direct is the evidence and how independent of any detailed theory. The well-established white dwarfs like Sirius B have a mass directly deduced from the law of gravitation and an observed double star orbit. They have an absolute luminosity determined from their distance (parallax) and their observed apparent luminosity. In view of the simplicity and universality of the theories involved in these deductions, no one will dispute that mass and absolute luminosity have the certainty of direct observations. To determine a density, a radius is required as well as a mass, and the radius must be deduced from the absolute luminosity and the surface temperature via the thermodynamic laws of radiation and the theory of the flux of radiation emerging from a gaseous atmosphere. Even in this step the maximal observational and theoretical uncertainties are not very great. If we know the surface temperature and the absolute luminosity, we can determine the surface area of the star, apart from possible uncertainties, at most of the order of 50 per cent, arising from conceivable errors in the radiative theory. All depends, therefore, on a determination of surface temperature, to which parameter the resulting mean density is rather sensitive, as it varies as the sixth power of this temperature.

There are two main methods of determining surface temperature. One can assume that the quality of stellar radiation, apart from line absorptions, follows closely Planck's black body curve; after observing the energy distribution in the spectrum of the star, one can fit Planck curves to it and thereby determine the temperature from the curves of best fit. This method is known to underestimate the temperature considerably, especially for the higher surface temperatures, and is not reliable for the stars in question. But the theory of ionisation in stellar atmospheres and of the production of absorption lines in an ionised atmosphere enables one to assign a surface temperature when the surface value of gravity is known and also the spectral *type*. The possible resultant uncertainties in this application of theory do not appear to be very great. It is true that the surface value of gravity is not known initially, but it is known when the radius is determined, and the problem of determining the surface temperature is therefore solvable in theory, and also in practice, at worst by a process of successive approximation. This is admittedly the most uncertain step in the deduction of the radius and therefore of the density, but if we suppose that a maximum uncertainty of a factor of 10 could thereby be introduced into the density, we shall have allowed more than amply for all errors at present conceivable, and the existence of excessively dense matter must be regarded as fully established. Taking a reasonable view of probable observational and theoretical uncertainties, it is most unlikely that the current accepted mean densities for the best determined white dwarfs, such as Sirius B, are in error by a factor nearly so large.

Prof. Milne then passes on to the problem of the frequency of such dense matter in our galaxy. There are very few directly well observed white dwarfs, but the conditions for a good determination, owing to absolute faintness and the necessity for a well determined parallax and double star orbit, are very severe, and the fact that we know only four such stars is consistent with a great abundance of such stars in our galaxy. The essential conditions for a white dwarf are a relatively low absolute luminosity combined with a high surface temperature. There is reason to believe that these properties are found together in two remarkable classes of stars, the central stars of planetary nebulæ and ex-novæ. The evidence is reviewed by Milne, who concludes provisionally that the case is proved.

If correct, this conclusion is of the utmost importance, not so much for the greatly increased abundance of known dense objects as for its possible

* "The White Dwarf Stars", being the Halley Lecture delivered on May 19, 1932, by Prof. E. A. Milne. (Oxford: Clarendon Press. 1932.)

evolutionary significance. It has been suggested by Prof. Milne, on purely theoretical grounds, that stars in general are in one of two states which may be called expanded and collapsed (Milne's centrally condensed and collapsed configurations respectively), and that the passage from one state to the other sets in at a certain critical stage in the evolutionary history and is of a cataclysmic nature. It is suggested, in short, that the evolving star, perhaps towards the end of its radiating life, becomes a nova and then a white dwarf. The outburst of radiation during the transient nova stage is the star's means of getting rid of the great difference of energy between the contiguous expanded and collapsed states. While it is still too early to be confident of the correctness of the theory underlying Milne's suggestion, the suggestion itself is a very happy one, likely—right or wrong—to prove extremely fertile. Milne's discussion already shows that an evolutionary sequence, ordinary star—nova—white dwarf, is by no means irreconcilable with the known facts, and indeed co-ordinates a great part of the facts in a most satisfying manner.

The second half of the Halley Lecture describes the present state of knowledge of the theory of stellar configurations—the generalisations that have sprung in the last three years from Eddington's pioneer work on the radiative equilibrium of a sphere of perfect highly ionised gas. These generalisations are still in an early stage of development. Milne himself, who initiated them and has been the prime mover in their development, would, I believe, be the last to claim that the equilibrium states of any model yet computed really reproduce the properties of any ordinary star. The collapsed white dwarf states appear to be simpler and to be satisfactorily accounted for by models already computed. They consist mainly of a rather cool, dense, almost isothermal core, the properties of which are controlled by those of a degenerate electron gas. But although existing models have not yet been made to mimic the observed properties of ordinary stars, we can see that this study of models has already infused new life into the theories of stellar evolution, and has taken us perhaps one long step nearer to the goal so rashly proposed as attainable in the last sentence of Eddington's "Internal Constitution of the Stars"—the goal of understanding so simple a thing as a star.

R. H. F.

The British Association Standards of Electrical Resistance, 1862-1932

FEW realise how much the electrical industry owes to the Electrical Standards Committee of the British Association, first appointed at the Manchester meeting in 1861. We welcome, therefore, the paper entitled "Material Standard of Resistance: the B.A. Coils, 1881–1932", read by Sir Richard Glazebrook and Dr. Hartshorn to Section A (Mathematical and Physical Sciences), at the York meeting on September 1. The Electrical Standards Committee in its first report (Cambridge, 1862) stated that it had first to determine the most convenient unit of resistance and, secondly, the best form and material for the standard representing that unit. The C.G.S. system of measurement was the outcome of its deliberations, and this decision has done more than perhaps any other single act in simplifying and unifying electrical measurements throughout the world.

Experiments were made at King's College, London, by Maxwell and Fleeming Jenkin to obtain the ohm in a material form, and reports giving their results were issued in 1863 and 1864. In Appendix A of the Report for 1865 it was recommended that the material of the wire from which the resistance standard be made should be an alloy containing 66 per cent silver and 33 per cent platinum. It was agreed that copies of the standard should be made and preserved at Kew Observatory. In the Report for 1867 a table is given of the values of the standards in question. This Committee was dissolved in 1870. Soon after Maxwell's appointment as Cavendish professor of experimental physics at Cambridge, the coils were brought to the Cavendish Laboratory and were used by Chrystal in 1876. Lord Rayleigh succeeded Maxwell in 1879 and at once became interested in electrical measurements. Rowland of Baltimore had thrown doubts on the accuracy of the absolute measurements of the B.A. Committee. Rayleigh and Schuster's experiments at Cambridge confirmed these doubts, and from 1881 onwards great activity was shown at the Cavendish Laboratory in investigating the question of electric units. In 1879–81, Dr. J. A. Fleming made a very careful comparison of the B.A. coils. He found that their relative values had changed appreciably, and he adopted as a definition of the B.A. unit the mean value of the resistance found from all the coils at the temperatures at which they were originally said to be correct.

The Electrical Standards Committee was reappointed in 1880; and in 1881, R. T. Glazebrook became connected with the work. He was appointed secretary in 1883, and the coils were in his charge from that date until 1919. They are still at the National Physical Laboratory. The Standards Committee was dissolved in 1912. Up to that date, comparisons of the coils between themselves were continually in progress, and their values were determined in ohms and also in terms of the length of a column of mercury by Rayleigh, Glazebrook, Fitzpatrick, and F. E. Smith. The records show that most of the coils have changed appreciably during their long life, but that the two platinum coils included in the original group have remained unchanged.

The point of most importance that emerged from Sir Frank Smith's measurements of 1908 was the performance of the two platinum coils, now marked 'D' and 'E'. The value of these coils in B.A. units in 1888, 1908, and 1932 obtained from a comparison

with mercury tubes, assuming that the resistance of 1 metre of mercury is 0·95352 B.A. units, is given in the accompanying table:

Coil.	1888 (R. T. G.).	1908 (F. E. S.).	1932 (Hartshorn).
D	1·00013	1·00012	1·00011
E	1·00073	1·00072	1·00071

The coils have been very carefully intercompared this year at the National Physical Laboratory and their value determined in terms of the international ohm by Dr. Hartshorn. The international ohm is defined as the resistance at 0° C. of a column of mercury 106·300 cm. in length and 1 sq. mm. in cross section. Tables are given illustrating how the values found for the coils during the last sixty-five years have varied. These show that considerable variations appeared prior to 1888. These depend probably on errors arising in the temperature determinations of 'D' and 'E', as an uncertainty in the temperature of these coils of 0·1° C. implies an uncertainty of 0·0003 B.A. units in the resistance measurements.

In the platinum-silver coils 'F' and 'G' appreciable changes were noted between 1880 and 1908. These are probably due to the fact that during that period the coils were on several occasions measured at 0° C.; strains may have been produced at the soft soldered joints. In recent years, when the coils have been maintained at a temperature not far removed from 16° C., the changes have been remarkably small.

The main conclusion to be drawn from the series of investigations from 1865 to the present date is that the platinum coils 'D' and 'E' have retained their value unchanged, while changes have occurred in all the coils made of alloys. These changes are partly due to the violent temperature changes to which all the coils have been subjected at various times.

We may also conclude that pure metals like platinum are usually more stable in their properties than alloys like manganin. Unfortunately, the pure metals suitable for standards have temperature coefficients varying from 0·003 to 0·007, so measurements would have to be taken at 0° C., as this is practically the only temperature at which they can be maintained sufficiently constant.

Obituary

Prof. W. Stirling

William Stirling, formerly Brackenbury professor of physiology at the University of Manchester, died on October 1. Prior to his going to Manchester he held the regius chair of the Institutes of Medicine at Aberdeen.

Stirling was born at Grangemouth in 1851, received his early education at the Dollar Academy and then became an undergraduate at Edinburgh. Here he had a career of great distinction, graduating as B.Sc. in 1870 and two years later as D.Sc., M.B. and C.M. In his medical final examination he was awarded first class honours. He also gained the Baxter scholarship, the Falconer fellowship and Ettles prize. His thesis in 1875 on "The Summation of Electrical Stimuli applied to the Skin" brought him the M.D. degree and with it the gold medal. After his student career in Edinburgh he worked in Leipzig, Berlin and Paris, and then returned to Edinburgh as demonstrator under Rutherford. His election to the regius chair at Aberdeen shortly after this time and when he was but twenty-six years old, indicates clearly the great promise of his early years and the esteem in which he was held.

After eleven years in Aberdeen, during which time he introduced there the practical teaching of physiology, Stirling was elected as successor to Arthur Gamgee in the chair of physiology at Owens College, Manchester. Here he remained until his retirement in 1919.

Stirling became a professional physiologist at a time when the teaching of physiology in many of the medical schools of Great Britain was inadequate and very little research work was done. In France and Germany, however, the subject in the hands of such masters as Bernard, Helmholz and Ludwig, had developed into an important experimental science. It is not surprising, therefore, that Stirling's sojourn abroad inspired in him a great affection for the men under whom he had studied, and this was apparent from his frequent references to them in his lectures and in private conversation. Carl Ludwig especially was held by him in great regard.

Nevertheless, although in his early post-graduate days Stirling carried out promising research work, he eventually became an interpreter of the work of others rather than an investigator himself. Both at Aberdeen and in Manchester, he introduced elaborate methods of teaching and was largely responsible in the latter school for the extension of the medical building which houses the present physiological laboratories. In addition to his work for his own department at Manchester, Stirling acted as Dean of the Medical School from 1902 until 1913, showing himself to be a capable administrator and devoting himself wholeheartedly to the general welfare of the School. It is probable that these heavy administrative duties coupled with the labours involved in bringing into being the new medical buildings were largely responsible for the attention he devoted to exposition rather than to physiological research. Of his publications, probably the best known are his "Apostles of Physiology", "Outlines of Practical Physiology" and the "Text Book of Physiology" by Landois and Stirling; the last-named being a translation of Landois's book, to which Stirling made many valuable additions.

Stirling was a man who made many friends and did not easily lose them. His fine stature, impres-

sive manner and mode of dress made him a striking figure. Men who were his students still talk of his attractive personality, the great clarity and interest of his lectures and the minute detail with which his practical classes were organised. As a popular lecturer he was in great demand and through this became widely known. This stimulation of interest in biological science in the latter part of last century was probably of great value in gaining support for the scientific departments of the university colleges of the north of England in their earlier days.

In 1904 Stirling received the honorary degree of LL.D. from the University of Glasgow and in 1906 he was Fullerian professor of physiology at the Royal Institution, London. H. S. R.

Dr. F. H. Hatch

THE death of Dr. Frederick Henry Hatch on September 22, at sixty-eight years of age, will be regretted by numerous friends in mining and metallurgical circles. Dr. Hatch was born in London, and after studying at University College, proceeded to the University of Bonn, where he took the degree of Ph.D. He spent six years as a member of H.M. Geological Survey, when his work was largely petrological, dealing especially with the igneous rocks of Scotland.

Dr. Hatch recognised, however, that there was a great opportunity for a geologist in the then newly discovered goldfield of the Witwatersrand, and in 1892 he resigned his appointment and went to the Transvaal, where he soon achieved a high reputation as a mining engineer and consulting geologist. He undertook exploration work of the highest importance for various gold-mining interests, his most significant work in Africa being that in connexion with the development of the eastern extension of the Rand goldfield, in the region where the reefs disappear below a great thickness of newer rocks.

In 1895 Dr. Hatch became associated with Cecil Rhodes and John Hayes Hammond in the development of Rhodesia, but the Jameson Raid and the Boer War caused such a general disturbance of this and all his other work that he left Africa for some time, visiting the United States, Canada, British Columbia, and Abyssinia. He also spent a year in India, investigating the gold resources of that country for the Government. His report on the Kolar goldfield may be regarded as a classic in mining literature. At the close of the Boer War he returned to Johannesburg. An intensive boring campaign under his advice finally revealed the structure of the East Rand, which is now the most important producing area, and rendered its development practicable. About 1906 Dr. Hatch left Africa for England, where he established a large practice as a consulting mining engineer, visiting Siberia and other countries. In 1909 he undertook on behalf of the Government an investigation of the mineral resources of Natal.

From 1910 to 1913 Dr. Hatch resided in Cambridge, where he lectured on economic geology and presented to the University a very fine collection of specimens of metalliferous ores collected during the course of his professional work. In 1914 he was president of the Institution of Mining and Metallurgy.

After the outbreak of the War, during which he lost his two elder sons, Dr. Hatch was engaged in the Ministry of Munitions and played a prominent part in the organisation of home supplies of iron ores, a piece of work which was of immense service in the organisation of victory. After the War he reported on the condition of the iron and steel works in Lorraine, in the occupied areas of Germany, in Belgium and in France, and then became director of the Mineral Resources Development Branch of the Board of Trade and technical adviser to the Mines Department.

In addition to all this, however, Dr. Hatch was a man of high attainments on the side of pure science. He was the author of books on mineralogy, petrology, and ore deposits which did much to render these subjects intelligible to the average student. The number of editions is evidence of their success and usefulness. In the last few years petrology has become infinitely and perhaps unnecessarily complicated, but nevertheless many of the existing classifications of rocks bear a strong imprint of the common-sense system of the editions of Hatch's "Petrology" of 1907 and later years. R. H. R.

Sir Everard im Thurn, K.C.M.G., K.B.E.

THE death of Sir Everard Ferdinand im Thurn, colonial administrator, anthropologist and naturalist, at eighty years of age, took place on October 8 at his residence, Cockenzie House, Prestonpans. The son of John Conrad im Thurn, merchant-banker, he was educated at Marlborough and at Exeter College, Oxford. Before going to Oxford he had already in 1869 published a book on the birds of Marlborough. In 1877 he went to British Guiana as curator of the museum. He there took up the scientific study of the country and its peoples, being the first to ascend Roraima, and publishing a work on the botanical results of that expedition. In 1882 he was appointed judge in the Pomerun District and in 1890 was made Government Agent in the North-Western District. He joined the staff of the Colonial Office in 1899, having been made C.M.G. in 1892, and was made C.B. in 1900. He was appointed Colonial Secretary and Lieutenant-Governor of Ceylon in 1901 and Governor of Fiji and High Commissioner of the Pacific in 1904. In the following year he was promoted to K.C.M.G. and in 1910 he retired. In 1918 he was made a K.B.E. From 1919 until 1921 he was president of the Royal Anthropological Institute, and on taking up his residence in Scotland shortly after he had held that office, he helped to organise and became the first local president of the Edinburgh branch of the Institute.

Sir Everard im Thurn was the author of many papers on the history and geography of British Guiana, Ceylon and the South Seas. He also wrote a number of books. "A Tramp with Red-Skins" appeared in 1886 and "A Sketch of the Ceylon Pearl Fishery" in 1903. It was, however, by his "Among the Indians of Guiana" (1883) that his work was best known throughout his life. This, especially in view of the date at which it was written, is an outstanding piece of work, showing a remarkable range in knowledge and understanding of the ways of thought of a people of backward culture—qualities which served im Thurn well as an administrator in the Pacific. The book was for long, and still continues in some degree to be, a standard work of reference for anthropologists in comparative work. His last considerable undertaking was the editing, in conjunction with Mr. L. C. Wharton, for the Hakluyt Society, of "The Journal of William Lockerby, Sandalwood Trader in the Fijian Islands, 1808–9", published in 1925, to which he contributed an introduction and notes embodying a mass of valuable information. Sir Everard himself considered that this book contained his best work.

After his retirement, Sir Everard's leisure was far from unoccupied, and his advice, assistance and knowledge were freely at the disposal of all who were interested in geographical and anthropological questions relating to the South Seas. In 1925 his services to science were recognised by his old college when he was elected an honorary fellow.

WE regret to announce the following deaths:

Mr. A. Chaston Chapman, F.R.S., a past president of the Society of Public Analysts, the Royal Microscopical Society and the Institute of Chemistry, on October 17, aged sixty-two years.

Prof. O. D. Kellogg, professor of mathematics at Harvard University, known chiefly for his work in the calculus, on August 27, aged fifty-four years.

Prof. Edgar James Swift, professor of psychology at Washington University, St. Louis, who has carried out many investigations in applied psychology, on August 30, aged seventy-two years.

Mr. Arthur Silva White, formerly secretary of the Royal Scottish Geographical Society and assistant secretary to the British Association in 1904–9, author of books on Egypt and Africa, on October 12, aged seventy-three years.

Prof. Max Wolf, professor of astronomy in the University of Heidelberg, associate of the Royal Astronomical Society and foreign associate of the U.S. National Academy of Sciences, on October 3, aged sixty-nine years.

News and Views

A Self-Styled Faculty of Sciences

SEVERAL correspondents have sent us copies of a letter and circular which they have recently received inviting them to become fellows of a body having the title "The International Faculty of Sciences", with an office at 36 Gordon Square, London, W.C.1. The preliminary prospectus, issued more than a year ago, did not include the word "International" and was the subject of some severe comments in *Truth* of September 16, 1931. The new circular, which appears to have been widely distributed, invites application to be made for admission "as a Fellow of the Faculty of Sciences" and states that "The application of every candidate for fellowship must be accompanied by a remittance of one guinea." After election, "every Fellow is entitled to use after his name the initials 'F.F.Sc.' ". There is, of course, no relation whatever between this International Faculty of Sciences and the Faculty of Science of the University of London, though the similar title adopted by the new body must lead to misunderstanding in the minds of many people. The president and vice-presidents of this body are stated upon the circular to be as follows:—"President: Prof. H. W. Blood Ryan, M.A., D.Sc., LL.D., Ph.D. Vice-Presidents: Prof. Ingo W. D. Hackh; Prof. R. F. Hunter, D.Sc., Ph.D., D.I.C., A.R.C.Sc.; Prof. Nicholas Knight, A.M., Ph.D.; Prof. Cyril Krauz; Prof. Marius Rebek, Ph.D." As the body is "International" in its title, it is perhaps not surprising that only one of these names appears in the "Universities Year-Book" which includes members of staffs of all the universities of the British Empire, namely, that of Prof. Hunter, who occupies the chair of chemistry in the Aligarh Muslim University, Aligarh. The president himself does not appear in the "Year-Book", but we believe he has associations with Cornell College, which is at Mount Vernon, Iowa, affiliated with the Methodist Episcopal Church, and not in any way to be confused with the great Cornell University at Ithaca, New York.

A "College" in an Office

IN addition to his association with the International Faculty of Sciences, H. W. Blood Ryan is also honorary director of the College of Pestology. We referred to that institution so long ago as December 12, 1925, when we pointed out that it is a propagandist body and not an educational institution. The "College" has a registered office at 52 Bedford Square, London, W.C.1; but though it seems to be concerned mainly with insect pests, not a single entomologist of eminence or authority is included in the list of political and other public people whose names appear upon its publications. There is apparently nothing to prevent any individual or group adopting the designation University or Faculty or College and inviting persons to join

such a self-styled body. We have no observations to make upon the objects and activities of the two bodies of this type referred to above, but scientific workers must themselves decide whether either a "Faculty" or "College", constituted as we have stated, merits their support.

Major E. E. Austen

MAJOR E. E. AUSTEN retired from the keepership of the Department of Entomology in the British Museum (Natural History) on October 19, when he reached the age limit of sixty-five years. After an education at Rugby School and the University of Heidelberg, he entered the service of the Trustees of the British Museum as second class assistant (now termed assistant keeper) in what was then the entomological section of the Department of Zoology on October 30, 1899, and was placed in charge of the Diptera; to this group of insects he has devoted his scientific life. The entomological section was separated from the Department of Zoology in 1913 with Dr. C. J. Gahan as the first keeper; on his retirement, Major Austen succeeded to the office on January 21, 1927. His last official act was to bring out the long wanted number on Clothes Moths and House Moths in the Natural History Museum economic series. As the blood-sucking flies are in the group studied by him, he has been brought closely into contact with tropical medicine. He was with the first expedition of the Liverpool School of Tropical Medicine to Sierra Leone in 1899, and has been a member of the council as well as vice-president of the Royal Society of Tropical Medicine and Hygiene. He has served on many committees including those on sleeping sickness, tsetse fly, and locust. He is a member of the committee of management of the Imperial Institute of Entomology. In early days a volunteer and later a territorial, he saw service in the Boer War and in the European War; in the latter he was twice mentioned in dispatches and was awarded the Distinguished Service Order. Mr. N. D. Riley succeeds Major Austen as keeper, and Mr. K. G. Blair has been appointed deputy keeper in the Department of Entomology of the Museum.

The Asiatic Society of Bengal

ALTHOUGH scientific workers in many fields are familiar with the publications of the Asiatic Society of Bengal, few, probably, are aware of the mass influence of this ancient foundation upon Indian progress. A glimpse of the long history of the Society was given by Dr. Rai Upendra Nath Brahmachari, in his presidential address in 1929, just published in the *Journal and Proceedings* (N.S., vol. 25, 1932). Founded in 1784, as the result of an appeal by Sir William Jones for the institution of a society to inquire into the history, civil and natural, the antiquities, arts, sciences and literature of Asia, and numbering amongst its early patrons Warren Hastings and Lord Cornwallis, the Asiatic Society set going inquiries of a kind which had fallen into abeyance in the India of the late eighteenth century. Its "Asiatic Researches" created so great an impression in the literary world that in 1798 a pirated edition was brought out in England, and on the Continent a French edition, "Recherches Asiatiques", appeared in Paris. So early as 1808, a year after the formation of the Geological Society of London and only eighteen years after Werner had propounded at Freiburg his doctrine of "Formations", a special committee was formed "to propose such plans and carry on such correspondence as might seem best suited to promote the Natural History, Philosophy, Medicine, improvements of the Arts and Sciences and whatever is comprehended in the general term Physics".

AT first geology and mineralogy received most attention, and the names of many distinguished workers figure amongst the early contributors—Voysey the father of Indian geology, Oldham who created the Geological Survey of India, Lambton of the Indian Survey, Schwendler one of the chief founders of the Calcutta Zoological Gardens, Falconer, Cautley, Colvin, Baker, Durand, to mention a few. Indeed there are few activities in the scientific life of India which have not been linked with the Asiatic Society, from the early ethnological survey of Col. Dalton, and the grand series of papers on the fossil mammalian fauna of the Sub-Himalayas, to the foundation of the Indian Museum and its off-shoot the Zoological Survey. The president added a note of warning about the risk of starting new scientific periodicals, the competition of which might result in the double misfortune of loss both to the new and the old, and made a plea for consideration of the possibility of concentrating upon the oldest journal of all, the *Journal of the Asiatic Society of Bengal*, with which, he considers, many of the new journals might be amalgamated profitably.

Ultra-Short Wave Radio Link across Bristol Channel

ONE of the results of the study of the mode of propagation of ultra-short electric waves has been to show that for wave-lengths of from one to about nine metres, the effective range is limited to the horizon or the optical distance for ordinary vision. While this property prevents the application of such waves for long distance radio communication, it has for some time been recognised that this range of wave-lengths would be very suitable for providing a radio link in the ordinary telephone system. This application is of particular advantage in spanning short stretches of water, such as a channel or river estuary, where the present alternative is a submarine cable or a land-line following a circuitous route. According to recent reports in the *Times* and the *Wireless World*, the Post Office Engineering Department has been investigating the possibilities of this application for some time past, and experiments have now successfully terminated in the setting-up of a radio link across the Bristol Channel. This link, which is twelve miles long, connects up the ordinary telephone land-lines at Lavernock, near Cardiff, on one side, with those at Hutton, near Weston-super-Mare, on the other. The wave-length employed is about five metres, and the transmitters and receivers are placed in separate huts at each site. The aerial

system consists of horizontal dipoles connected to the terminal apparatus by special transmission lines, and the whole equipment has been designed to work unattended, apart from periodic maintenance operations.

British Standard Specifications

THE British Standards Institution has for its principal object the co-ordination of the efforts of producers and users for the improvement, standardisation, and simplification of engineering and industrial materials. It specifies standards both of quality and of dimensions in order to assist production and distribution and to eliminate waste of time and material involved in the unnecessary variation of articles made for the same purpose. Thereby it contributes to safety as well as to efficiency in industry, as is evidenced by the recent publication of a British standard specification for the identification of chemical pipe lines. The proposed scheme, which was prepared at the joint request of the British Chemical Manufacturers' Association and the British Chemical Plant Manufacturers' Association, identifies the nature of the liquids or gases conveyed by means of coloured plates, bearing a distinctive letter or sign, which are to be placed adjacent to the control valve and at intervals along the pipe. Thus a workman can immediately ascertain whether a certain pipe conveys inflammable, explosive, toxic, or corrosive material, whether the contents are under pressure, or whether the pipe line is safe. The matter might at first sight appear to be a trivial one which could be left to the common sense of works managers; in practice, however, the proposed universal device will help to avoid the possibility of emergencies ending in tragedies.

Research on Coal and Coke

THE third annual report of the Northern Coke Research Committee records the many-sided activities of its staff working in the Armstrong College, Newcastle, on problems of the coals and cokes of the north of England. Like most organisations, the Committee now labours under restrictions imposed by the financial stringencies of the times. Apart from fundamental long-range investigations, there is an immediate need for documented information about the characteristics of commercial fuels, which is felt by anyone concerned with the rational choice and utilisation of available coals. To-day coal is no longer the unchallenged king of fuels. The tendency with all commodities is to look for products regular in supply, of high and uniform quality. In all these respects coal has displayed an inferiority against its competitors, and it is hard to see how the industry can maintain its position against its competitors by abandoning or diminishing efforts to inform itself about the properties of its wares. The Report for 1930–31 of the Department of Mining and Fuel Technology of the University of Sheffield also records a wide range of investigations connected with the winning and utilisation of coal, many of which have already been noticed in our pages.

Modern Tendencies in Bird Taxonomy

THE appearance of a fourth edition of the American Check List of Birds in 1931 has suggested to Joseph Grinnell a comparison between its contents and that of previous editions (*Auk*, Jan. 1932, p. 9). The result is a vivid picture of the tendency of modern taxonomic studies. The first edition appeared in 1886, and subsequent editions in 1895, 1910, and now the fourth in 1931. The total number of forms, species, and sub-species listed in these editions was 951, 1068, 1196, and 1420, a very considerable increase in about a working life-time. But a further examination shows that the increase is not equally distributed: the numbers of full species were 768, 799, 802 and 811, a remarkable stability of numbers during the period, less than one new species a year being described. On the other hand, the number of sub-species has mounted very greatly—183, 269, 394 and 609—and the tendency to multiply sub-species is shown most strongly in the last edition. There has been a great advance in the identification of fossil species, the numbers of which run, 46, 64, 72, and 156, but this is a very natural development, for recent years have seen intensive fossil collecting in many areas. The author's idea is that the tendency marked in the new edition is bound to grow, that interest in phylogeny and species-making are counterparts, and that the "species factory in nature is the only resort in final analysis for learning the true nature of the speciation process. More and more alert, students in the field of systematics will develop a facility and technique of discrimination scarcely to be dreamed of now." On the other hand, it is possible that the future will bring, rather than a development of description for its own sake, an association between specific or sub-specific forms and their environment so close that systematic description apart from reference to peculiarities of life-conditions will be regarded as inadequate.

Progress at Colombo Museum

THE building of a new west wing, a new isolated archæological gallery for stone remains, and a small building for the entomologists' department and reserve collections, has provided nearly 13,000 square feet of additional space for the public collections of the Colombo Museum. The exterior of the west wing conforms with the style of the older portion of the museum, and the block, which, as a photograph shows, is a very handsome structure, stands out as one of the finest buildings in Colombo. It is illustrative of the difficulties of museum lighting that although at most seasons the light is too intense for specimens and sight-seeing, during cloudy days in the monsoon period the lighting in the old building was found to be inadequate, and accordingly special provision has been made for artificial lighting from the roof and within the cases (Administration Report of the Director of the Colombo Museum for 1931). Many additions have been made to the Museum collections, but the section which still retains greatest hold upon the visitor is the collection of living animals, which contains a good selection of mammals

and birds, and to which a large new aviary has been added. Schools in and about Colombo make increasing use of this collection, and 8,127 scholars visited the Museum with their teachers during the year. Approximately 225,000 people entered the Museum in 1931, amongst which there were three times as many 'strangers' as European residents.

Work of the Meteorological Office

The Annual Report of the Director of the Meteorological Office for the year ended March 31, 1932 (London: H.M. Stationery Office. 1*s*. net.), deals with the seventy-seventh year of the Meteorological Office. Although the work has continued on the main lines followed in recent years, this year has seen the conclusion of a scheme of re-organisation of the arrangements made at the London headquarters for the preparation of weather forecasts. Under the revised arrangements a single branch only is concerned with forecasts, whereas formerly forecasts for aviation were done by one branch and all other forecasts by another—an awkward arrangement involving a certain amount of duplication, and one which is not justified by any essential difference between the two types of forecast. This internal re-organisation has had its counterpart in a simplification of the exchange of weather information by wireless telegraphy between different countries. This year has also seen the commencement of a scheme of co-operation with the Automobile Association in the supply of meteorological information, including forecasts, to private persons flying their own aeroplanes. The only other work of an exceptional character was in connexion with the second International Polar Year. A number of countries, including Great Britain, are co-operating in obtaining data from high latitudes for the study of meteorology and terrestrial magnetism, and are organising expeditions for that purpose. The share allotted to the Meteorological Office consists of an expedition to Fort Rae, in Canada.

Warfare on Eddystone Island

A communication received from Mr. R. A. Lover of Tulagi, British Solomons, referring to a Research Item in Nature of June 11, p. 872, based on a paper by Mr. A. M. Hocart on warfare in Eddystone Island of the Solomons (*J. Roy. Anthrop. Inst.*, vol. 61, pt. 2) points out that the only weapons to be seen now among the islanders are light spears and bows and arrows for shooting fish and small birds, while head-hunting, murder and adultery, to which Mr. Hocart had referred as the causes of strife, have long been dealt with under the British protectorate, as in all other parts of the globe where we have any share in the government. In fairness to Mr. Hocart, it must be pointed out that the brief paragraph in our columns summarises a paper of 24 pages. Reference to Mr. Hocart's complete paper will show that he was dealing with conditions in the island when he visited it in 1908–9, and further, that in describing as a whole this aspect of native culture, he covered practices which were obsolete, or had fallen into disuse not long before his visit, as well as customs which he himself observed or of which he was informed. At times, both in his own narrative and in that of his informants, he makes use of the historic present, but the context makes it clear whether he intends a reference to what was then current or to what had become obsolete.

The New York Aquarium

The most noteworthy event at the Aquarium of the New York Zoological Society, recorded in the Director's Report for 1931, was the establishment and opening of a new department for the exhibition of the smaller fresh-water tropical fishes. At the opening in December, 120 species of diminutive fresh-water fishes from many distant tropical localities were shown, and since many of these are suitable for keeping in home aquaria, part of the exhibit was a demonstration tank showing a balanced aquarium of mixed fishes suitable for such a purpose. The thoroughness with which the world is combed for the stocking of the tropical fresh-water tanks is well illustrated by a map showing collecting grounds in 43 localities, ranging from the Americas to Africa, India, Malaya, and Australia. Only one European locality, in Spain, has contributed to the tropical collection and only one to the collection of temperate fishes. An interesting activity of the Aquarium is the distribution from the hatchery of quantities of fish eggs and young fishes at different stages of development to high schools for biological studies. In addition to the year's grant of 76,167 dollars, the City of New York voted 245 dollars towards salaries for temporary labour and 1,000 dollars for the hiring of labourers for 200 days at 5 dollars a day, thereby helping to relieve the condition of unemployment. The Zoological Society provided from its own funds an additional 22,761 dollars. In the course of the year the Aquarium was visited by 2,453,806 persons.

Destruction of Hawks in the United States

It is remarkable that the many ornithological associations in the United States were unable for thirteen years to prevent the State-encouraged slaughter of hawks in Maryland. In a short article in the *Condor* (1932, p. 187), Prof. A. Brazier Howell gives some indication of what the bounty payment of 50 cents for each hawk (the law was intended to apply to the sharp-shinned and Cooper's hawks only) meant to the hawk population and to the public purse. From a total of 7 individuals killed in 1918, the year of the passing of the anti-hawk legislation, the annual slaughter reached 20,081 in 1923–24, and 22,283 in 1929–30, when the bounty was repealed. In all, during the thirteen years when the bounty was in force, 62,543 dollars were paid for 125,086 hawks. Unfortunately, the effect spread far beyond the bounds for which the Maryland legislators were responsible, for the inducement of the bounty led individuals to make a profitable business of hawk-hunting, particularly during autumn, when thousands of migrating hawks remain for short periods on passage. In the five years 1926–1930, a well-known

resting ground of such migrants furnished 40,003 hawks, or 55 per cent of the total kill during that period, and a single hawk-hunter was rewarded in 1930 to the tune of 900 dollars. It was against much opposition that Mr. E. Le Compte, the State game warden, finally succeeded in inducing the legislature to withdraw the bounty.

A Capsid Bug New in Britain

IN the *Entomologist's Monthly Magazine* for August 1932, Mr. W. E. China, of the British Museum (Natural History), discusses the occurrence of large numbers of a very small capsid on apple trees in a nursery near Chertsey, Surrey. The species *Campylomma nicolasi* Put. and Reut. is an inhabitant of the Mediterranean region and its appearance in Surrey in large numbers is of special interest. The genus *Campylomma* contains ten palæarctic species but none has previously been found in Britain. It seems unlikely that the species *C. nicolasi* is an indigenous insect, since it could scarcely have been overlooked in so well-worked a county as Surrey. Mr. China is of opinion that it is more likely to have been introduced with some Mediterranean plant, since the eggs of the family Capsidæ are almost invariably inserted into plant tissues. Whether a southern insect of this kind will survive the English climate seems questionable: the description and figure given by him will enable it to be identified should it be found again in subsequent years.

South London Entomological and Natural History Society

THE *Proceedings of the South London Entomological and Natural History Society* for 1931–32 forms the record of its sixteenth year of existence and contains several articles of interest to students of insects. Mention may be made of the contribution of Mr. A. E. Tonge, dealing with the characters of the eggs of British noctuid moths. The eggs of a large number of the species have been examined by him and briefly described and a proportion of them figured in four excellent photographic plates. Dr. E. A. Cockayne describes the larva of *Dysstroma concinnata*, and Mr. C. N. Hawkins discusses the pupæ in that genus. Among other articles, Mrs. K. Grant's account of aquatic Hymenoptera and Mr H. J. Turner's discussion on the classification of the British plume moths are also noteworthy. The volume is well produced and fully indexed, and may be obtained at the Society's rooms in Hibernia Chambers, London Bridge, S.E., price 12*s*. 6*d*.

Congress of Polish Physicists

THE sixth Congress of Polish Physicists was held in Warsaw on September 29–October 1, under the presidency of Prof. Ladislas Natanson, professor in the Jagellonian University, Cracow. The president, in his introductory address, spoke on "James Clerk Maxwell's Childhood and Boyhood". The principal subjects chosen for discussion included: the fortunes and misfortunes of physical theories, the polarisation of dielectrics, the physical interpretation of quantum mechanics, problems of nuclear physics, the connexion of physical science with engineering, general relativity, theory of band spectra, teaching of physics, etc., the chief contributors being Profs. Rubinowicz, Zakrzowski, Bialobrzeski, Wertenstein, Wolfke, Weyssenhoff, Patkowski, and others. Prof. Malarski, of Lwow (Leopol), dealt with "Maryan Smoluchowski's Life and Work". More than 120 miscellaneous papers were also presented. The Congress was decidedly successful, about three hundred members taking part in the proceedings. The next Congress will be held in Cracow in 1934.

Engineers' German Circle

THE Engineers' German Circle (Deutscher Ingenieurzirkel in London) was formed in 1931, with the joint support of the Institution of Mechanical Engineers, London, and of the Verein deutscher Ingenieure, Berlin, to further the study of technical German, to give opportunities of hearing lectures in German by eminent German-speaking technical men, and to bring together engineers interested in Continental technical developments. Meetings are held at the Institution of Mechanical Engineers about once every four weeks during the sessions, on Mondays at 6 P.M. Members meet for tea and social intercourse from 5.15 P.M. Lectures are, so far as possible, illustrated with lantern slides, in order to help members to understand better the technical terms involved; and as a rule, they last about forty minutes, which allows time for a short discussion in German to follow. The lecturers are asked to use simple language and to speak slowly for the benefit of those not very familiar with German. The present session opened on Oct. 10. The subscription to the Circle is 5*s*. a year, and the Secretary is Mr. H. P. Spratt, Science Museum, London, S.W.7.

Researches in Wood Preservation

IN addition to some useful notes on timber-treating plants in the British Isles, and on the preservation of timber investigations being carried out at research institutes and forest products laboratories, vol. 2 of the *Journal of the British Wood Preserving Association* includes some interesting papers read before meetings of the Association during the year, accompanied by valuable discussions both from the point of view of the expert and the practical commercial man. Amongst these are "The Structure of Wood", by L. Chalk; "Recent Developments in Wood Preservation", by H. Fergusson; and a general discussion on the fire-proofing of timber. Other interesting material was afforded by the papers on "The Preservation of Mining Timber on the Witwatersrand", by H. A. Read; "Experiments on Wood Preservation in the Sea", by J. H. Orton; and "Wood Structure and Penetration of Preservatives", by F. J. Popham. In an editorial note it is stated that the steady growth of the Association continues. The exhibits at agricultural shows and the lectures given by the Secretary to the various clubs and scientific associations in many parts of the country bring the merits of scientific wood preservation before a large public. Inquiries from abroad have increased, particularly from the Colonies,

and the Secretary is now in direct touch with a large number of timber users and research workers throughout the world.

Psychology of Delinquency

"STUDIES IN THE PSYCHOLOGY OF DELINQUENCY", by Grace W. Pailthorpe (Medical Research Council, Special Report Series. No. 170), represents the result of five years work on the psychology of inmates of prisons and of preventive and rescue homes. The investigation aims at finding out what treatment would lead to a restoration of these people to the ranks of the normal. It is necessary to note that a criminal is not necessarily quite different from other people; he has been found out. Dr. Pailthorpe gives details of an investigation of 200 subjects, 100 in prisons and 100 in homes. The subjects were tested for intelligence, and classified accordingly, as normal, sub-normal, and defective. The prison group proved to have a higher proportion of normals. It is not infrequently asserted that prison people are defective in intelligence: some certainly are, but some are not. They were also interviewed, and classified according to their emotional attitudes. This part of the report is excellent and the detailed case histories are very valuable. It seems obvious on reading them that our present alternatives in dealing with criminals are hopelessly inadequate and wasteful of money as well as of the human material. A large number show clear signs of mental lack of balance, and it should be part of an enlightened society's work to try to find out the cause. Hence the writer makes a plea for a study of the mentality of the criminal as well as of the crime, and discusses various alternative methods of treatment, including segregation, permanent supervision, education and psychotherapy. Many of the prisoners are really mentally sick, and if there were legal recognition of these conditions some murders might be prevented. In an appendix there is an account of some prison systems abroad.

Announcements

PROF. J. A. CROWTHER, professor of physics in the University of Reading since 1924, has been elected honorary secretary of the Institute of Physics, in succession to Prof. A. O. Rankine.

REFERRING to Prof. P. G. H. Boswell's letter in NATURE of August 13 on the subject of the age of the Oldoway skeleton, Dr. L. S. B. Leakey writes to say that he is returning to England at the end of December, and hopes then to be able to place the whole evidence against Prof. Boswell's conclusions before scientific investigators.

THE first Hinchley Memorial Lecture of the Institution of Chemical Engineers will be delivered at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1, by Mr. H. T. Tizard, on October 28, at 6.30 P.M. The subject of Mr. Tizard's lecture will be "Chemical Engineering and the Aircraft Industry".

THE Lord President of the Council has appointed Prof. A. Fowler and Sir Clement Hindley to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research in succession to Sir Alfred Ewing and Sir David Milne-Watson, who have retired on completion of their terms of office. The Lord President of the Council has also appointed Brigadier-General Sir Harold Hartley to be chairman of the Fuel Research Board, and Dr. N. V. Sidgwick to be chairman of the Chemistry Research Board of the Department of Scientific and Industrial Research, in succession to the late Sir Richard Threlfall.

THE eighth volume (Pt. 2, Science Section) of the Allahabad Univ. Studies (1932) contains half a dozen papers from the Department of Zoology, five from that of Chemistry and one each from the Departments of Botany and Physics. In the first group it is natural that the work of the head of the department (Prof. Bhattacharya) should be reflected in the investigations of his pupils and two of the papers are on the Golgi bodies and other cytoplasmic structures in the eggs of Indian snakes and of the crab, *Scylla serrata*. Other papers record the congenital absence of limbs in tortoises, the structure of the gonad in a hen-feathered cock, and a number of new species of trematodes. Of the chemical papers, that on the formation of inorganic jellies may be noted.

MESSRS. NEGRETTI AND ZAMBRA have placed on the market a portable sampling hygrometer adapted for the measurement of the hygrometric conditions inside bundles of fabric, wool, fibres, etc. The instrument is of the hair hygrometer type fitted with a tube through which a sample of air is withdrawn from the bundle and circulated through the hygrometer case, which is completely air-tight except for the inlet and outlet air connexions.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A research student in the Institute of Pathology and Research at St. Mary's Hospital, Paddington, W.2—The Secretary (Oct. 24). An assistant lecturer in mathematics at the Technical College, Cardiff—The Director of Education, City Hall, Cardiff (Oct. 29). A junior lecturer in the Department of Pathology at the University of Liverpool—The Registrar (Oct. 31). An assistant lands officer in the Works and Buildings Directorate of the Air Ministry—The Secretary (S.2), Air Ministry, Adastral House, Kingsway, W.C.2 (Nov. 1). An assistant lecturer in metallurgy at the University of Leeds—The Registrar (Nov. 7). A part-time instructor of economics and economic history at the Kingston-upon-Thames Technical College—The Principal. A teacher of elementary science, including biology, and a mistress to teach geography, at the Medway Technical College, Day Technical School for Girls, Chatham—The District Education Officer, 15, New Road Avenue, Chatham. A valve physicist and designer at the Murphy Radio Laboratories, Welwyn Garden City, Herts.

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Reviews

Mary Kingsley

The Life of Mary Kingsley. By Stephen Gwynn. Pp. viii + 272 + 2 plates. (London: Macmillan and Co., Ltd., 1932.) 12*s.* 6*d.* net.

IN the last eight years of her too-short life, Mary Kingsley crowded many experiences. Until the age of thirty she lived a life of domestic seclusion, fifteen years being devoted to the care of an invalid mother and a delicate brother, while at the same time she assisted her father in the preparation of a work, never completed, on native law and religion. When in 1892 the death of her father and mother within a few weeks of one another left her free to follow her own bent, she set out on her travels, her choice of West Africa being determined largely by a desire to collect first-hand information for the continuation of the work upon which she had been engaged with her father. It is a testimony to the strength of her character, also, perhaps, to its peculiar quality, that notwithstanding her previous sheltered existence, she could adapt herself to West Coast society of the 'nineties—a society of traders and ships' captains which held itself aloof from the official element—and was proud to be of its fellowship, and could steel herself to the dangers of travel in the forest, alone, unescorted and unarmed, with members of cannibal tribes for her guides and carriers, among villages in which the chances were much less than even that she and her party would meet with a friendly welcome.

Mr. Stephen Gwynn's "Life", save for a few deft touches from personal recollection, leaves the sketching of Mary Kingsley's character in the main to herself. By a skilful selection from her "Travels", lectures and letters—many of the letters, unfortunately, have vanished—there emerges a detailed portrait of a remarkable personality, a personality which combined the zest for adventure and the spirit of a sixteenth century English seaman-explorer with a passion for justice and honour in dealings between governors and governed, whether the latter were the traders, who, as she saw it, were doing a great work for England and, given favourable conditions, might do more, or the natives of Britain's dependencies and protectorates. But with all her sympathetic understanding of those on whose behalf she fought, she was no sentimentalist. Both trader and native she saw as they were, and without illusion, even as, on the other side, she was always ready to do justice to the merits of her opponents; and next to this passion for justice, in the picture as Mr. Gwynn composes it, comes her genius for humour, impish and unconventional, with which she so often veiled her seriousness of purpose and almost missionary zeal.

When Mary Kingsley left England for South Africa, where she died in 1900 while nursing Boer prisoners of war, she carried with her a sense of defeat. In 1898 her projected third journey to West Africa was abandoned, as it proved for ever, in order to carry on a campaign on behalf of what she held to be the interests of both England and West Africa. In this she felt that she had failed, even though she had been consulted privately by Mr. Joseph Chamberlain, then in charge of the Colonial Office.

On the publication of her "Travels in West Africa" Mary Kingsley had involved herself in replies to critics of her views on native customs and beliefs, on missionaries and on the supply of intoxicating liquor to natives; but the development of international affairs in Africa, in which the future of the Niger Company with Sir Charles Goldie at its head was implicated, and the serious unrest among the natives which arose as a result of the imposition of the Sierra Leone hut-tax, raised issues which to her were even more vital.

Mr. Gwynn briefly, but adequately, sketches the course of relations between England and France in West Africa at this time in so far as they affected Mary Kingsley's hopes for British expansion and the development of British commercial interests in tropical Africa; but this is a matter of history. What is still a vital issue, although thanks to Lord Lugard its recognition has been won in West Africa, is the principle upon which she took her stand in the native question, namely, that native institutions should be

recognised in the relations between the administration and the native. She pointed out that the imposition of the hut-tax was a violation of treaty rights because it conflicted with native ideas of ownership of property which had not been affected by the treaties. On the general question she stated her position quite clearly. In her "West African Studies" she said (pp. 331–2) :—"I hold that one of the most awful crimes one nation can commit on another is destroying the image of justice, which in an institution is represented more truly to the people by whom the institution has been developed than in any alien institution of Justice ; it is a thing adapted to its environment. This form of murder by a nation I see being done in the destruction of what is good in the laws and institutions of native races."

On the other hand, she was equally clear in her recognition of the right or duty of the governing race to suppress, if necessary by force, practices which were repugnant to the more advanced conception of civilisation.

Mary Kingsley had a distrust of theoretical anthropologists, just as she had of stay-at-home administrators and philanthropists ; but it is evident that she appreciated anthropological work in the field in its bearing on the problems of government as providing a basis of understanding of native institutions and of the native attitude of mind towards administrative action affecting those institutions. It would be a mistake to exaggerate the part played by her ; but the interval of thirty years which has elapsed since her death has given perspective. Her work by no means failed so completely in its effect as she feared. This she would have recognised had she known that within a few years of her death, the Government of Southern Nigeria was to appoint experimentally a government ethnologist, paving the way to the work of such officials as Rattray, Talbot, Meek and others in preparation for, or as a concomitant of, a system of administration in which native institutions and native rulers play a recognised part. But progress is slow and acceptance of the principle is not even yet general.

What generations of anthropologists have urged upon the governments of their day, what individual administrators, not only in Mary Kingsley's time but also before, had realised as the result of their experience, it has taken the driving force of a Lord Lugard in West Africa and a Sir Hubert Murray in Papua to bring into actual operation. Incredible as it may seem, in some areas it is still possible for those responsible for administration—and this applies also to mission work—to say in all seriousness that their subordinates "have not the time" to study and observe the natives in their charge.

The Human Factor in Industry

Ten Years of Industrial Psychology : an Account of the First Decade of the National Institute of Industrial Psychology. By Henry J. Welch and Charles S. Myers. Pp. ix + 146 + 9 plates. (London : Sir Isaac Pitman and Sons, Ltd., 1932.) 6*s*. net.

ONE of the difficulties which besets the investigator of the human factor in industry is the relative length of time which is frequently necessary before sound deductions can be drawn from his experimental investigations and observations. The application of scientific methods to investigation of industrial problems in which the human element is a principal factor is a departure in Great Britain which is almost if not exclusively confined to the post-War decade. In this field the formation in 1920 of the National Institute of Industrial Psychology is an outstanding feature, and this very readable account of its activities during its first decade contributed by H. J. Welch, chairman and honorary treasurer of the Institute and Dr. C. S. Myers, its principal, contains abundant material for justifying the initiation of this important experiment. The Institute has already become a living and growing organisation rich in experience and fruitful in services rendered, to which we can look with confidence for assistance in the solution of many serious problems in our industrial and social life.

The Institute was formed specifically for the determination and application of psychological and physiological principles and methods in the solution of the human problems of industry and commerce, and from the outset it was stressed that its work should be scientific and not for profit. The investigation and improvement of actual working conditions and methods in factories, offices, etc. ; the study of personnel organisation, including methods of selecting staff, training, promotion, incentives, etc. ; and the giving of vocational guidance based on the physiological and psychological study of abilities and of temperamental qualities, were methods adopted by the Institute from the start, and within its first two years all the main lines of its present activities

were being actively developed, including its important educational work, courses of lectures, etc.

The survey of ten years' work as presented in the volume under review, affords sufficient material for enabling some reasoned judgment to be formed of the value of the contribution of science in this field and the developments to be expected. Certain aspects of the Institute's work have indeed earned high praise in many quarters but this summary of its activities demonstrates very clearly how closely many of them are related. Vocational guidance and selection are two aspects of one problem and in turn are closely related to problems of industrial safety and efficiency, while the wide practice of vocational guidance and selection is in turn dependent upon the success of the Institute's educational activities.

The Institute has already become the acknowledged headquarters of research in vocational guidance and selection, and despite the increased difficulty of work in this field due to the magnitude of the unemployment problem to-day, there is no sphere of its work which is of wider importance. In the difficulty of finding posts for boys or girls leaving school, the importance of finding the right post is liable to be overlooked. The experience already gained by the Institute has demonstrated not only the extent to which misfits are a source of inefficiency and accidents in industry but also the positive contribution which vocational guidance and selection can make from the point of view of both employer and employee. On one hand, it enables the employer to secure the type of worker best fitted for the positions he has to fill. On the other hand, it tends to prevent that drifting from one unsuitable position to another which has so demoralising an influence on the adolescent and tends to aggravate that gravest aspect of our unemployment problem to-day, the creation of unemployables. It is clear that the study of these problems in a scientific spirit is of vital importance, and if at the present time it is not always possible to direct the boy or girl leaving school into the ideal occupations for individual talents, the risk of a serious and demoralising misfit can be greatly minimised.

The Institute has as yet only been able to touch the fringe of this problem. Its results need application on a far greater scale and its methods and investigations need extending to all parts of the country and to all classes of occupations, including in these days of educational economy, the selection for higher education of those best fitted to profit by it. The absence of adequate vocational guidance is lamentably plain and the contrast between the careers of those entering industry unguided and those whose selection of a career is based on scientific guidance is so significant that, even in these days of stringent economy, the nation cannot afford indefinitely to incur this unnecessary waste, or to ignore the risk that anxiety at the present moment to secure any position may result in a succession of demoralising misfits and an increase in the unemployables.

The work of the Institute in this field is typical of the preventive as contrasted with remedial methods which characterise the penetration of science into any field of human endeavour. This aspect, far more than the mere raising of industrial efficiency, is the most impressive, and the better health, less fatigue and greater capacity of the worker to enjoy his leisure hours which have resulted from the Institute's industrial and commercial investigations, should be sufficient answer to those who at the present time might have objected to the simultaneous raising of the efficiency of industrial processes or operations as liable to increase unemployment. Investigations on fatigue, lighting, ventilation, noise, physiology of work, and numerous applications of psychology have demonstrated that the elimination of waste of effort, and the reduction of needless physical and mental strain which scientific thought can thus effect, hold benefits even more important to the community than are the financial benefits to industry. This contribution has hitherto been limited largely to the production side of industry. Its extension to the distributive side of industry and commerce, and indeed to all sides of government and municipal life, as well as to the home conditions which so largely shape the health and happiness of the worker, is urgently required. The present volume should assist in rousing the wider interest and fuller support required for such expansion of the Institute's invaluable work.

R. B.

Exploring New Guinea

Across New Guinea from the Fly to the Sepik. By Ivan F. Champion. Pp. xix + 267 + 24 plates. (London: Constable and Co. Ltd., 1932.) **15s.** net.

THIS book is the simple record of a very remarkable achievement—the first crossing of New Guinea from south to north in its widest

part. From the latest maps it was evident that the sources of the greatest rivers in that island, the Fly and the Sĕpik, were not far apart, but that particular area was unexplored, as are many parts of the interior. A certain amount of information about the upper waters of the Fly was available, thanks to the work of Leo Austen and other officers of the Papuan Government, but there was a blank space on the map, and as Sir Hubert Murray, the Lieutenant-Governor of Papua, says in his introduction to Mr. Champion's work, "The crossing must be done some day, and it was unthinkable that it should be done by any but officers of the Papuan service." The ordinary routine work of that service often necessitates difficult and risky journeys into the interior, so that many of the officers have performed notable explorations which have greatly added to geographical and ethnographical knowledge, but whose exploits are for the most part unknown except to those who delve into the annual reports. Thus it is not surprising that, given the opportunity, two thoroughly efficient officers should be found to attempt the adventure here narrated with slender means and without preliminary publicity.

The leadership was entrusted to Mr. C. H. Karius, and Mr. Ivan F. Champion, who was born in Papua, was appointed his colleague. The first expedition started in December 1926 and arrived at its camp, No. 10, 615 miles up the Fly on March 31, 1927, having traversed on foot nearly a thousand miles. This was where its real work was to begin, but the carriers were by then thoroughly tired of the trip. They had carried 40lb. loads, and having carried a load they had to go back over the same track more than once and get another, with rice as practically their sole diet. Before them were ramparts of sharp brittle limestone with neither water nor soil, over which they painfully attempted to crawl, but they were forced to return. Another track over a limestone ridge was more promising, but these and other attempts of the two explorers, who tried different routes, proved abortive. An alarming feature in one district was the crashing down of mountain sides.

At Mount Blücher the party divided. Karius went north-east and reached the head of a valley that led northwards to the Sĕpik, but lack of supplies forced him to return and he followed a river that turned out to be the Strickland. Champion went north-west and traced the Luap or Palmer River to its source, and passed down the Bol to the village of Bolivip where, though the natives had never seen a white man, they were royally entertained. He then made a trip to near the source of a mysterious river, the Feneng, which afterwards proved to be the Fly, and heard of another to the north, the Takin, which Champion conjectured could be no other than the Sĕpik. The carriers were worn out and the food all but exhausted so he had to return to Mount Blücher. There, at Camp 10, they made rafts by means of which they travelled 500 miles down the Fly after many exciting adventures. In the estuary of the Fly the two parties were reunited on July 12 and they reached Port Moresby on July 17.

On September 17 the explorers left Port Moresby for a second attempt, this time taking with them 32 carriers from the d'Entrecasteaux, sturdy, hardy men, accustomed to climbing mountains, unlike the former carriers, who came from the estuary of the Fly; there were also 14 armed native constables and 26 prisoners. In due course they reached Bolivip; the natives were friendly but were greatly depressed because owing to a lean season they could not provide their visitors with an ample supply of food. After some difficulty, they persuaded the chief, Tamsimara, to conduct them to the Takin, for the Bolivip people occasionally crossed the divide to join in feasts at Feramin. They went up the Amil affluent of the Bol, and soon came to limestone walls that were most difficult to climb. Everything was saturated with moisture and the icy blasts froze the carriers; at an altitude of 8900 ft. the rain had diminished somewhat but it was still blowing and bitterly cold. The limestone country became worse and worse, rocks with razor-like edges to clamber over, chasms to cross by rotten tree trunks, they descended into large pot-holes varying from 50 yd. to 100 yd. in diameter and from 30 ft. to 100 ft. deep and had to clamber out of them. There was no water and no level ground. The highest camp was at 8300 ft.

In due time the expedition reached the divide at a height of 9000 ft., when the track began to go down, but they were enshrouded in mist and rain and no compass bearing could be made. There were still dangerous chasms to be crossed, but at last they were on a small grass plateau at a height of 7000 ft. in bright sunlight with a magnificent panorama in front of them. On a projecting rock stood Tamsimara calling out "Wok Takin!" They saw where the Takin started its flow in a narrow ravine to the east formed by two spurs of the

Victor Emanuel Range. The last days' march had been too much for the carriers, whose spirits had dropped to zero, but the leaders and the police were jubilant. "Little did they know, as we did, that it was but the commencement of our trials and tribulations." Tamsimara, who was really a remarkable person, introduced the travellers to the people of the village of Feramin, before he made a dramatic farewell. The Feramin received them kindly but had very little food to sell.

The next part of the journey was also difficult and owing to an accident Champion had a bad knee and had to be carried in a stretcher for several days, which greatly impeded their progress. They had only 11 days reduced rations left and were still in the mountains. Karius as usual remained undaunted: "he could take defeat in the matter-of-fact manner with which he met success". They had now arrived at a point where it was possible to identify features marked on German maps of the Sĕpik and at times were able to obtain sweet potatoes and sugar cane from the natives, who were friendly but had to be handled with care.

For eleven days Champion had practically lived on the stretcher, and though lame he made up his mind to attempt to walk, and managed to hobble along. There was now food only for five days and the mouth of the river was 600 miles away. Difficult mountain land had still to be traversed and rivers crossed, but on December 23, 1927, they looked upon the great inland plain and an hour later the mountain journey had ended. In a forest glade Karius came suddenly upon a village, the men rushed out fully armed with bows and arrows and drew up in a line three men deep; the quiet courage of Karius saved the situation and shouts of defiance changed into calls of welcome. Here they were able to buy 160 lb. of sago.

They had to leave the Sĕpik and travel into the hilly hinterland and were now in Netherlands New Guinea. They crossed the Hoffnungs River and came to another which proved to be the Holländer; here they made rafts but these were wrecked and lives were nearly lost. The police lost their rifles: "It hurt them more than anything could do. They accepted hunger, fatigue, and even death as a part of their work, but to return to Port Moresby without their rifles was too much." Food ran out and Karius and Champion were down with diarrhœa and fever; fortunately they were able to make sago, but a carrier, who had collapsed in the swamps, died—the only death on the expedition. Rafts were again made and they soon shot into the main river. On January 19, 1928, 500 miles up the Sĕpik they saw the *Elevala*, which had been sent from Port Moresby to meet them. "The silence was broken by the sobs and hysterical laughter of the police and carriers who madly clutched at one another, and who then, with triumphant shouts, reached for the oars." Thus ends the book.

Mr. Champion has given us a fascinating, though restrained, record of a most memorable expedition into the unknown. Travelling in the interior of New Guinea is exceptionally difficult and dangerous; food has to be carried and it must be remembered that "a carrier himself will, in a month, eat the load of rice he starts off with", so sufficient stores had to be carried inland to the point from which the final dash was to be made. Travelling in the limestone mountains was a nightmare; besides lack of food and the lurking of diseases and accidents, there were unknown natives to be placated. The Papuan service affords good training for all these emergencies and its fine tradition of dealing with natives enabled the explorers to make friends with suspicious savages even when their attitude was aggressive. The behaviour of the native police was, as usual, efficient and cheerful, and the carriers and prisoners, almost without exception, worked hard and with loyalty. Mr. Karius has well deserved the gold medal awarded to him by the Royal Geographical Society. A. C. HADDON.

Dwarf Succulents

Mesembryanthema: Descriptions, with Chapters on Cultivation and General Ecology. By Dr. N. E. Brown, Dr. A. Tischer and M. C. Karsten. Pp. xxvi + 323. (Ashford: L. Reeve and Co. Ltd., 1931.) 36*s*. net.

THE group of plants known as mesembryanthemums is almost exclusively of South African origin and contains a great diversity of growth forms. In the work under notice, attention is confined to the 'dwarf', 'stone' or 'sphaeroid' types. These are the peculiar forms localised in the Karroo and Namaqualand, where the rainfall averages 5–10 in. a year. Light intensity and day temperatures are high and the conditions generally are extremely severe. It is owing to these factors that some plants have developed the small succulent habit to such a high degree of efficiency.

For nearly two centuries, mesembryanthemums have attracted the attention of horticulturists, but owing to the specialised conditions required for successful growth, their cultivation was somewhat restricted until comparatively recently. Latterly, however, mesembryanthemums, American cacti and other dwarf succulents have been adopted by the general public, particularly on the Continent, to decorate window boxes. Miniature gardens in bowls and various other designs have also gained great popularity.

While general interest was at its height, Dr. N. E. Brown, after many years of intensive study, decided that the Linnean genus *Mesembryanthemum* should be divided into a number of smaller genera, and in 1925 commenced the publication of his views. Not long after, Dr. Schwantes, in Germany, and Mrs. L. Bolus, in South Africa, followed a similar course, and since then many articles have been published containing new genera and species. It need scarcely be added that much of the work of these authors has overlapped and considerably more than a hundred new genera have been described and the synonymy increased unnecessarily. To give examples from the work under review: *Conophytum pellucidum, Schwant.*; syn.: *C. elegans*, N. E. Br.; *Lithops Marlothii*, N. E. Br.; *Ophthalmophyllum Marlothii*, Schwant.; and another, *Bijlia cana, N. E. Br.*; syn.: *Mesembryanthemum canum*, Haw.; *M. Tugwelliæ*, L. Bol. *Juttadinteria Tugwelliæ*, Swant.; *Hereroa Tugwelliæ*, L. Bol. *Bolusanthemum Tugwelliæ*, Schwant.

The necessity for such an authoritative publication on these plants requires no further emphasis, and coming as it does at a time of wide public interest in its subject, there is no doubt it will meet a real demand. In order to make it a work of wider reference, the editor, E. J. Labarre, decided to have the text printed in English, German and Dutch. Dr. Tischer is responsible for the opening chapter on cultivation, which is followed by a chapter on ecology by Miss Karsten. To these two authors fell the task of translating the main body of the work by Brown, consisting of short descriptions of a large number of species, accompanied by excellent illustrations. Brown's care and exceptional knowledge of the group is a guarantee of accurate and useful information. The photographs, by various authors, and two coloured plates by N. E. Brown are of outstanding merit.

In the chapter on general ecology, a large number of examples of mimicry in plants is given, where the plants resemble in colour and shape the stones amongst which they grow, and the inference is that the plants have directed their evolutionary progress; but the section concludes with the very necessary warning that this aspect may not be of such importance as hitherto imagined; and that the environment, for example, light, temperature, humidity, soil, etc., working as a whole, is the directive force, is the generally accepted view of modern thought. Prominence is given to the ravages of beasts and birds, particularly of ostriches, but since the ostrich feather has fallen from women's favour, the menace has largely disappeared. On the other hand, the more recent popularity of succulents throughout the world has resulted in collectors taking even greater toll of the wild plants for commercial purposes. This brings one to the consideration of propagation and regeneration. Dr. Tischer gives a host of valuable hints on these points. The reviewer would emphasise the success which attends propagation from seed and cuttings, and if these means are more fully developed, the demand for fresh supplies from the native haunts will be lessened, and this is greatly to be desired.

"Mesembryanthema", although not claiming to be an exhaustive treatise on dwarf species, is an important work of reference, and every serious cultivator of these plants will find it indispensable.

Animal Picture Books

(1) *Seen by the Camera: Beauty in Animals.* Pp. xvi + 64 plates. (London: George Routledge and Sons, Ltd., n.d.) 2*s.* 6*d.* net.

(2) *Monsters of Primeval Days.* With Foreword and Descriptive Notes by Dr. W. E. Swinton. Pp. 38 + 24 plates. (London: Figurehead, 1931.) 2*s.* net; paper, 1*s.* net.

(3) *Nature by Night.* By Arthur R. Thompson. Pp. xiii + 144 + 44 plates. (London: Ivor Nicholson and Watson, Ltd., 1931.) 12*s.* 6*d.* net.

(4) *The Life Story of Beasts.* By Eric Fitch Daglish. Pp. x + 223 + 21 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1931.) 6*s.* net.

(5) *Fishes.* By E. G. Boulenger. Pp. 174 + 8 plates. (London: Chapman and Hall, Ltd., 1931.) 7*s.* 6*d.* net.

(1) "BEAUTY in Animals" is introduced by Friedrich Schnack and consists of sixty-four photographs, mostly by Hedda Walther. The series of pictures of mammals and birds, "is the means to assist us to find the way to a higher view,

and to sharpen our understanding for it". Many of the pictures are of parts of animals and in most of the rest the animal fills up the greater part of the picture. We have never found a series of stuffed animals to excite the emotions and we are sure that these pictures will seldom do so. Why not let the publishers try again and show the animals alive in characteristic attitudes, or better, in their natural environment as Mr. Swinton has done in his "Monsters", mostly giants of earlier days (2). Here there are accurate reproductions of models representing the animals in natural motion, set in appropriate environments so as to form pictures. They look to us like superposed photographs, in other words, ancient beasts with modern plants. We do not object to this, for the gain is great, but we think a little more attention to composition and printing would make many of the pictures less confused. The text might be made still more popular, and why give specific names to most reptiles and to no mammals?

(3) "Nature by Night" is in a higher category both of art and science, dealing with animals that have their maximum activity in the hours of darkness. The numerous pictures of living animals are beautiful. Those by flashlight have a certain absence of colour values, but are peculiarly valuable as indicating nocturnal conditions. To the badger and the rabbit they must be nearly the same and the reader should examine and compare the photographs of these two at night and in the daytime. We ask for pictures of the stoat and weasel. The whole is illuminated by an admirable text with little introduction of matter not within the author's own knowledge. Every naturalist will find this book delightful reading, well worthy of a place in his library; teachers will feel that it greatly helps them. Its production is a credit to its publishers and its price is moderate.

(4) To the more sophisticated and modern, which few naturalists are, Mr. Daglish's book should appeal for its woodcut illustrations. Those which close the chapters are delightful. Of the full page illustrations some are anatomical, such as the whale and mole, but many suggest a vigorous existence with the beast using its environment intelligently and itself well adapted to it. The text is admirable throughout and singularly free from technical terms. The arrangement into chapters dealing with the food, homes, courtship, intelligence and other characters of beasts is good. This is an excellent little book.

(5) We wonder whether we shall be criticised for classifying "Fishes" as a picture book, but we think L. E. Brightwell had great fun in making line drawings from fish in the Zoological Society's Aquarium. We like the drawings, for the fish are alive, their salient features well shown and unnecessary detail omitted. The sawfish is a partial failure, and the copies of earlier figures of the young of the eel scarcely suggest this little transparent person. The tiny male of the angler fish, fused as a parasite to the body of the female, is of peculiar interest. The weaver's poison spine is an efficient defence even against man, for it is as good eating as the sole. The text is admirable, but few people will recognise the sail-finned and reed fishes as *Polypterus* and *Calamoichthys* of African freshwaters; the latter is not even put in the index. Otherwise it is a simple account of the very diverse forms and habits of fish. We recommend this book to all readers and trust that its next edition will be published at an even lower price so as to command the widest public.

A Subantarctic Island

South Georgia, the British Empire's Subantarctic Outpost: a Synopsis of the History of the Island. By L. Harrison Matthews. Pp. xii + 163 + 26 plates. (Bristol: John Wright and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1931.) 15*s*. net.

In view of the importance which South Georgia has assumed during the present century as one of the centres of the whaling industry, it is strange that no book on the island has hitherto been published. The account which Mr. Matthews gives is thus welcome, the more so since it is based on close personal acquaintance with the island and its industries.

The description of the island, with which the book opens, contains a good general account of the topography and notes on the climate and on the flora. The section on the fauna is the longest and it is here that the reader gains most from the author's first-hand knowledge. The account of the birds, seals and whales is excellently done, and even fuller treatment, especially of the courting ceremonies of the albatross, might have been given. The section on geology is less adequate, and the author is apparently unacquainted with Holtedahl's recent work.

The book, however, as the sub-title indicates, is mainly devoted to the history of the island, and

three of its six chapters deal successively with the early navigators, the sealers, and nineteenth century voyages. These chapters, which must have involved protracted research, are valuable in bringing together information from many widely scattered sources, and one feels there is little need for the apology that the author offers for the numerous quotations. Mr. Matthews has some new suggestions to make regarding the courses taken by la Rochè and Guyot, and though the sealers who followed in the track of eighteenth century exploration were reticent folk, more anxious to conceal than to advertise their movements, the collected information presents a good picture of their activities and of the ruthless methods which resulted in the virtual extermination of the fur seal.

The book concludes with an account of present-day conditions and some speculations as to future prospects. The history of modern antarctic whaling is traced from its beginnings in 1904, and the methods adopted in whaling and in taking elephant seal (South Georgia's only industries) are described. Much useful information is conveyed in an attractive form ; for it is blended with local anecdote, and while making good reading, succeeds in giving a vivid impression of life in the island. It is unfortunate that the author should quote, with evident approval, Gordon Hayes's criticisms of British territorial claims in this sector of the antarctic. Those unable to resist the temptation to decry the actions of their own government should first assure themselves that their facts are correct and the passage quoted from Hayes contains an inexcusable error.

There are many illustrations, but the omission of references to them in the text is inconvenient : a bibliography is given and a good index. For a comparatively short book the price seems high.

Photoelectricity

Photoelectric Phenomena. By Prof. A. Ll. Hughes and Prof. L. A. DuBridge. (International Series in Physics.) Pp. xii + 531. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 30s. net.

PROGRESS in the subject of photoelectricity has been so great during the past ten years that there was real need for an authoritative account of recent investigations. This need has now been supplied by the admirable volume by Profs. A. L. Hughes and L. A. DuBridge, whose book provides a concise yet comprehensive survey of this interesting field. After a short introduction, four chapters are devoted to the experimental results as to the emission of electrons from metal surfaces illuminated by visible or ultra-violet light. Chap. iii on "The Photoelectric Threshold" includes data for the work functions of the metals which should be of considerable use.

Chap. vi deals with theories of photoelectric emission, and though the authors modestly disclaim any special qualifications for dealing with theoretical problems, they have been very successful in giving an outline of this aspect of the subject. "The photoelectric effect, which has long been one of the cornerstones of the quantum theory of radiation, now finds itself closely intertwined with recent advances in quantum mechanics and the newer electron theory of metals." This chapter is divided into two main sections, the first dealing with the classical theory and the second with the Sommerfeld electron theory which has been developed by Fowler and Nordheim, Wentzel, and others. The transmission of electrons through potential barriers is one of the fundamental concepts of the new theory.

Two chapters follow, on the volume photoelectric effect, including the ionisation of gases and vapours by ultra-violet light and also photoconductivity in crystals, in partial conductors and in liquids. These contain a large amount of information not previously available in English. Photovoltaic effects and photoelectric effects in liquids and insulators are also treated.

Chaps. xii and xiii may be specially commended and should be studied by experimental physicists and by those who are concerned with the now numerous applications of photoelectricity. The former chapter is concerned with photoelectric technique and the latter with applications to photometry and to the transmission of pictures and of sound. One very striking illustration of the sensitiveness of the photoelectric method is afforded by the work of Rajewsky. Using a Geiger-Müller tube lined with a metal sensitive to the ultra-violet, the emission of single photoelectrons could be detected. Connecting the tube to an amplifier with a loud-speaker at the output end, it was possible to 'hear' the emission of each electron. The book is written in a very attractive style and is well produced.

H. S. ALLEN.

Short Reviews

Anthropology

At Home with the Savage. By J. H. Driberg. Pp. x+267+16 plates. (London: George Routledge and Sons, Ltd., 1932.) 7*s.* 6*d.* net.

MR. DRIBERG's "At Home with the Savage" is a remarkable book. It has an attractive title, it is popular in aim, and it contains nothing that the person of average intelligence should not be able to understand. Yet it is a book which has a very real significance from the point of view of science. Although the author expressly denies it the character of a textbook, it does, as a matter of fact, restate the subject matter of social anthropology from the point of view of the group of workers who study the activities of man as a member of a society in accordance with principles and methods which have come to be known as 'functional' anthropology.

A new orientation is given to the study of the peoples of the simpler cultures in which attention is diverted from questions of the origin or form of institutions and directed to consideration of how they actually work and what is their meaning and significance in a given environment. This concentration of anthropological studies on function was the subject of Prof. Radcliffe Brown's presidential address to the Anthropological Section of the British Association at its meeting last year, and has been demonstrated by Prof. Malinowski in a number of special studies; but Mr. Driberg's book is the first systematic statement of it as a whole on popular lines.

Its concrete treatment of the subject by the citation of a wealth of instances should convince the public for whom it is intended of the practical value of anthropological studies in the administration of the affairs of the native peoples of our dependencies. For this is a moral which the author never fails to point by pushing home the lesson of how difficulties may arise in these matters through the conflict of ideas as between ruler and ruled, and how they have, or might have, been avoided by a knowledge of anthropology.

It would perhaps be out of place in this notice to quarrel with Mr. Driberg for dismissing summarily branches of anthropology and methods of study other than those of his own school; yet perhaps even in support of his own point of view there might be something to say on the other side.

Tribes of the Niger Delta: their Religions and Customs. By Dr. P. Amaury Talbot. Pp. xi + 350 + 40 plates. (London: The Sheldon Press; New York and Toronto: The Macmillan Co., 1932.) 18*s.*

IN this volume Dr. Talbot describes the peoples of the Degama Division of Nigeria, who, broadly, fall into two groups—the Ibo people of the north, representing the southern-most extension of that great race, and the Ijaw, who occupy the swampy area intersected by innumerable streams along practically the whole coastal fringe, over a range of 250 miles. According to tradition, which Dr. Talbot apparently sees no reason to set aside, the whole of the latter area is sinking.

Be that as it may, the character of the environment has impressed itself very strongly on the culture of the Ijaw, which in many respects is of a markedly primitive character. One branch lives entirely by fishing and trading. These are the Kalabari, who at one time attained domination over the whole area owing to their proximity to the European slaver settlements. They now have practically a monopoly in the provision of dried fish, virtually a necessity in the dietary of the tribes. Another direction in which the influence of the environment is to be seen in a marked degree is the prominence of the water spirits in the religion of the Ijaw. The contrast with the culture of the Ibo is marked, though it is evident that there has been borrowing on the part of the latter. In his description of the customs and beliefs of the two groups, Dr. Talbot so far as possible has made use of evidence given by his native informants in practically their own words. Frequently it has been derived from his court records. This gives it an added value, especially in its revelation of the working of the native mind.

The photographs, as is usual in Dr. Talbot's books, are numerous and excellent, the subjects being chosen with a wise discrimination.

Biology

Handbuch der Pflanzenanalyse. Herausgegeben von G. Klein. Band 1: *Allgemeine Methoden der Pflanzenanalyse.* Bearbeitet von R. Brieger, F. Feigl, P. Hirsch, E. Keyssner, G. Klein, H. Kleinmann, G. Kögel, H. Lieb, H. Linser, J. Matula, L. Michælis, C. Weygand. Pp. xii + 627. (Wien und Berlin: Julius Springer, 1931.) 69 gold marks.

THE principal distinctive feature of this work is its breadth of outlook. While books on biochemical method normally give in detail the methods required for the estimation of particular substances in a plant tissue, this, while not neglecting such details, is principally concerned with the general analysis of a plant tissue or a substance, and more particularly with the principles governing the choice of methods and the principles involved in their application. Even a person moderately well acquainted with biochemistry will receive something of a shock on realising from a book of this type the extraordinary range of methods now available as aids in analysis of one form or another. Ultra-filtration and ultra-microscopy may give valuable information; fluorescence and photochemistry are also called upon for assistance and there are useful chapters on micro-methods and

histological chemical methods which should appeal especially to the general biologist.

The more familiar methods are treated in up-to-date manner and there are interesting chapters on extraction and preparation of material for analysis. A valuable feature of the book is, however, the inspiration which will come from the range of methods discussed.

Regeneration und Transplantation. Von Prof. Dr. E. Korschelt. Band 2: *Transplantation unter Berücksichtigung der Explantation, Pflanzenpfropfung und Parabiose.* Teil 1. Pp. xx + 695. (Berlin: Gebrüder Borntraeger, 1931.) 63 gold marks.

THIS is the second part of the enlarged edition of Prof. Korschelt's well-known book and deals exhaustively with the phenomena accompanying transplantation of parts or organs in plants and animals. It is an exhaustive survey of the known facts and brings together a great wealth of material from a widely scattered literature, and therefore forms an important source for all specialists.

Little or no attempt is made to deal with the philosophical significance of the experimental facts—possibly this is reserved for a later volume—but the book would have been of greater value as a textbook had points of theoretical significance been stressed at greater length at the expense of some of the descriptive data. The text and the figures are beautifully clear, and no biological library can afford to dispense with such a scholarly compilation of important work.

The phenomena of transplantation and regeneration are clearly of fundamental importance and, as in other aspects of experimental biology, new facts accumulate rapidly. It is, however, important that the literature of science should not become burdensome to students or to research workers. Whilst one hesitates to criticise the work of a distinguished author, at the same time, one cannot resist a feeling of regret that the field which Prof. Korschelt covers has been expanded so far beyond the modest dimensions of the first edition. Is it too much to hope that he will give us an abridged account of this interesting field—an account which will appeal to biologists generally and not primarily to specialists?

Elements of Water Bacteriology: with Special Reference to Sanitary Water Analysis. By Prof. S. C. Prescott and Prof. C. E. A. Winslow. Fifth edition, revised. Pp. ix + 219. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 12*s.* 6*d.* net.

THE authors, in this latest edition, give a valuable and comprehensive survey of the methods which can be used for the bacteriological analysis of water, with special reference to American practice. Their desire for the unification and simplification of these methods is a reasonable one, though the difficulty of fixing an arbitrary standard, as they themselves point out, is that each sample of water must be judged individually upon the correlative evidence as well as upon the bacteriological findings. The importance they attach to the distinction between *B. aerogenes* and *B. coli* would appear to be minimised by this fact, but, where the distinction is necessary, some recent work by Taylor and Goyle in India seems to show that Eijkman's method of incubating the primary cultures at 46°C. provides a sufficiently reliable demarcation between the saprophytic and intestinal strains of coliform bacilli without lengthening the routine examination.

The authors consider, justly, that averaging results of the bacteriological examination of a series of samples taken from the same water supply over a long period, is open to criticism, since this tends to obscure any temporary, and possibly dangerous, pollution of such a supply.

The book has a useful bibliography, but there are some misprints in the bacteriological table on p. 59 which might be confusing to the inexperienced worker.

The Biochemistry of Muscle. By Dr. Dorothy Moyle Needham. (Methuen's Monographs on Biological Subjects.) Pp. viii + 166. (London: Methuen and Co., Ltd., 1932.) 5*s.* net.

THE author of this monograph has clearly been handicapped by the extent of the published work that she has had to survey. To achieve this adequately she has been compelled to do nothing more than very curtly define the highly specialised terminology of the branch of biochemistry discussed, and this makes the book difficult to read for all those not actually engaged in the field. This unavoidable defect is, however, far more than balanced by the comprehensive nature of the treatment in an astonishingly short space. To have reviewed in 140 pages the voluminous researches of Hill, Embden, Meyerhof and their colleagues, with a bibliography of three hundred references, and an index, and to have reviewed it critically and comprehensively, is something for which many biochemists will be profoundly grateful, and to have given them this cause for gratitude at so low a price is a credit to the publishers.

Chemistry

Recent Advances in Analytical Chemistry. Vol. 2: *Inorganic Chemistry.* Editor: Dr. C. Ainsworth Mitchell. Contributors: Norman Evers, B. S. Evans, S. G. Clarke, W. R. Schoeller, A. T. Etheridge, Brynmor Jones, A. R. Powell, Janet Warden Brown, J. W. Haigh Johnson. Pp. xiv + 452. (London: J. and A. Churchill, 1931.) 15*s.*

IN addition to chapters recording recent work on the analytical chemistry of the elements, the volume includes chapters on the determination of hydrogen ion concentration and on potentiometric titrations, on microchemistry and on water and sewage analysis.

On the ground of economy of space, working details of new methods of analysis of the commoner elements are not given; these chapters are written on a plan very similar to that adopted in the Chemical Society's Annual Reports. This procedure has a defect: it does not afford the reader much guidance for selecting a method best adapted to particular circumstances. On the other hand, the chapters on the rarer elements, particularly those on selenium, tellurium and the acid earths, give adequate descriptions of the newest methods of their separation and determination. Space has been found for short but useful chapters describing the determination of gases in steel and the examination of graphites and carbon blacks.

The first chapter in the volume gives a good survey of modern methods of the determination of hydrogen ion concentration and of potentiometric titrations and includes a description of the glass electrode, which has been found to be so useful industrially. Microchemical methods are described in some detail with references to the use of coloured and impregnated threads and to 'spot' tests. Nephelometry receives less space than is due to its importance in biochemistry. There is a general discussion on the difficulties encountered in the problem of the determination of pollution in waters, and the shortcomings of the existing methods of analysis are indicated.

The book is well printed and assembled, free from errors, and has a good index. It should be on the shelves of all chemical libraries.

Lunge and Keane's Technical Methods of Chemical Analysis. Second edition. Edited by Dr. Charles A. Keane and Dr. P. C. L. Thorne. Vol. 3. Pp. xx + 678. (London and Edinburgh: Gurney and Jackson, 1931.) 63*s*. net.

THIS volume is a collection of treatises by well-known authors on clays, glass, cement, water, sewage and effluents, fertilisers, feeding stuffs, soils and air. Since the date of the publication of the previous edition (1908), so many improvements have been made in technical methods of analysis that the subject matter of the earlier volume has been much increased and largely rewritten. In the present volume the examination of clays is divided into two parts, chemical and physical, each with a separate author, an arrangement which reflects the increasing importance attached to their physical characters.

The methods of analysis described are representative of modern analytical procedure and, generally, little criticism is necessary. Among the methods used for the colorimetric determination of iron, no mention is made of the thioglycollic acid method, which is both delicate and independent of the state of oxidation of the iron. But it is gratifying to note that the very convenient method of titration of iron by means of titanous chloride is advocated.

Included in the section on air are the results of recent research on the gaseous impurities of the atmosphere of towns, including carbon monoxide, oxides of nitrogen and the acid oxides of sulphur. Subsequent work on the Government Laboratory method for the determination of the acid oxides of sulphur (p. 628) has shown that with a suitable indicator the method affords a reliable measure of these oxides in the air; in the absence of fog they have been found to be composed almost entirely of sulphur dioxide. A. G. F.

Handbook of Chemical Microscopy. By Prof. E. M. Chamot and Prof. C. W. Mason. Vol. 2: *Chemical Methods and Inorganic Qualitative Analysis.* Pp. ix + 411. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 22*s*. 6*d*. net.

THIS volume describes the manipulative methods of chemical microscopy; it is a compilation of reliable tests for inorganic cations and anions. In Chapters i and ii general and special manipulations are given in detail and special apparatus is illustrated. It may be noted that some of the apparatus needed for the manipulation of gases and volatile liquids shows a general resemblance to that used by Faraday in his 'minute' chemistry.

The next nine chapters contain detailed tests for the detection of the elements arranged in the groups of the periodic table and also for many inorganic anions. The reactions are well chosen and in many cases have stood the test of time, being those of Behrens, to whom the authors acknowledge their indebtedness. Many beautiful reproductions of photomicrographs of crystals are given and these increase the usefulness of the work; the authors, however, are careful to state that the illustrations must not take the place of the direct study of the tests.

Chapter xii describes the use of some special reagents and the separation of metals based upon their differences of electric potential. A scheme for the qualitative analysis of materials of unknown composition, including alloys, forms the last chapter of the book, which is completed by the addition of an appendix giving details of the preparation of the special reagents, and a good index.

Geology

German-English Geological Terminology: an Introduction to German and English Terms used in Geology, including Mineralogy, Petrology, Mineral Deposits, etc. By Dr. Arnold Cissarz and Dr. William R. Jones. Pp. xvii + 250. (London: Thomas Murby and Co.; Leipzig: Max Weg; New York: D. Van Nostrand Co., 1931.) 12*s*. 6*d*. net.

THIS work is intended for those who have already acquired some knowledge of German (or English), but are not familiar with German equivalents of the special terms used in the various branches of geology. The book is arranged on the lines of an elementary textbook and is bilingual. All scientific terms are italicised when first used. Equivalent

portions of the text are arranged on opposite pages, and corresponding paragraphs represent close translations one of the other. Literary style has been subordinated to the necessity for maintaining as nearly literal a relationship as possible between the English and German texts. Four appendices deal with abbreviations used in geological literature, English and German weights and measures, the chemical elements, and mineral names.

As a general criticism it may be suggested that the text is somewhat unbalanced with regard to the amount of space allotted to each of the several branches of geology. Thus, palæontology is represented solely by a chapter containing formal descriptions of the various groups of invertebrate fossils, while vertebrate palæontology and palæobotany are ignored. The principles of stratigraphy are dismissed in a single page. On the other hand, petrology, mineralogy, crystallography and allied subjects receive detailed treatment.

Some terms one would expect to have been included have been omitted, and a few spelling errors were noticed. As a whole the book can be recommended for the use of students. A mastery of its contents should adequately if not completely equip those who wish to read geological literature in the original German. V. A. E.

A Key to Mineral Groups, Species and Varieties. By Dr. E. S. Simpson. Pp. viii + 84. (London: Chapman and Hall, Ltd., 1932.) 10*s.* 6*d.* net.

It has always seemed a matter for regret that so many of the names applied to mineral species, even in recent years, give no indication whatever of the chemical composition or physical properties of the mineral. Instead of attempting to clarify the science by devising a self-explanatory system of nomenclature, mineralogists continue to increase the tax on their memories by attaching to new minerals quite irrational names. This being the case, Dr. Simpson justifiably claims that his tables may be regarded as a *vade mecum* to everyone interested in minerals. He has listed in alphabetical order upwards of 1800 mineral names. Opposite each mineral is stated concisely its chemical composition, specific gravity, crystal system and refractive indices. These data have been collected from the latest and most accurate sources available. In addition, reference is given in every case to a source of detailed information regarding each mineral. The latter item is particularly valuable in the case of the newer mineral species, about which data have, until now, remained scattered through many publications.

The literature of mineralogy is cumbered with a great number of useless names. The list is selective to the extent that the author has omitted names which he regards as obsolescent or which stand only for minute differences in unessential characteristics.

The tables represent a careful compilation by the author of information gathered from many sources over a long period of years. Dr. Simpson is to be congratulated on having made accessible to the public in such concise form the result of his labours.

The Microscopic Characters of Artificial Inorganic Solid Substances or Artificial Minerals. By Prof. A. N. Winchell. With a Chapter on the Universal Stage, by Prof. R. C. Emmons. Second edition. Pp. xvii + 403. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 31*s.* net.

Formerly known as "The Optic and Microscopic Characters of Artificial Minerals", the modification in the title of the new edition of this work serves to prevent misapprehension as to its scope. This is, in fact, much wider than would be the case if it dealt only with synthetic *minerals*, using the latter term in its generally accepted sense. The author has attempted to include all inorganic substances the optical constants of which are known.

Many changes have been made since the first edition appeared (Nature, vol. 122, p. 436, 1928). The book is now cloth bound, and has been greatly enlarged, chiefly through the introduction of a new section on optical principles and the methods of study of crystals under the microscope. This, Part I of the new edition, consists largely of revised selections from the same author's "Elements of Optical Mineralogy", Part I, third edition (see Nature, vol. 123, p. 158, 1929), and includes a chapter on the universal stage. Numerous alterations and additions have been made in the descriptive section of the book, and the determinative tables have been re-written and re-arranged.

The new section obviates the necessity for reference to other textbooks for those not familiar with the microscopic study of crystals and renders the book to a large extent self-contained. Altogether the new edition is a great improvement on the old.

Mathematical and Physical Science

Dielectric Constant and Molecular Structure. By Prof. C. P. Smyth. (American Chemical Society Monograph Series, No. 55.) Pp. 214. (New York: The Chemical Catalog Co. Inc., 1931.) 4 dollars.

This book effectively completes Debye's "Polar Molecules" and Errera's "Polarisation Diélectrique" by a detailed account of the subject in its relation to chemical constitution. Electrically polar molecules, its principal concern, have never been of so much importance in physics as the formally similar magnetic dipoles or as non-polar molecules, but the advent of thermionic valve methods for finding the dielectric constant opened up a wide field for their application in chemistry, development of which is due in no small degree to Prof. Smyth.

The subject matter falls roughly under three heads. The first three chapters are upon the elementary theory and the measurement of the

dielectric constant. The mathematics is not taken very far, but is adequate for the purpose of the monograph, whilst the account of experimental methods gains by Prof. Smyth's personal experience. The second and main section is upon the effect of structure, and includes chapters on the chief types of compounds (principally organic), electric moments and theories of valence, electronic and atomic polarisation, and molecular association. It is evident that much still remains to be done, both in the extension of measurements and in their interpretation, but Prof. Smyth has shown himself sufficiently master of the subject not to minimise difficulties. It would not be surprising if a number of these were found to be connected with quantum resonance, or were resolved in some similar manner in the theory of molecules now coming from Hund, Slater and others. The last section consists of tables of molecular moments.

Debye and Errera have left Prof. Smyth with the least interesting part of the work ; he is to be congratulated on having made it readable as well as useful.

A Textbook of Thermodynamics. By F. E. Hoare. Pp. xii+271. (London : Edward Arnold and Co., 1931.) 15*s.* net.

MR. HOARE has been successful in writing a treatise on thermodynamics which gives a very clear account of the theoretical side of the subject and an unusually detailed description of its applications. The reviewer has had an opportunity of testing some parts of the book in a recent course on thermodynamics of an introductory character and has found the descriptions both accurate and lucid. The author, who holds the diploma of the Imperial College, has evidently been influenced by the teaching of the late Prof. Callendar, and excellent use is made of the latter's work on the properties of steam. Experimental results are frequently quoted, and some numerical examples are included in the text. For the benefit of the student who finds difficulty in applying thermodynamic principles in practical cases, we should like to see numerical exercises added in a second edition. The work can be recommended to students who are taking an honours degree in physics.

We note that Mr. Hoare does not adopt the terms 'enthalpy' or 'free energy'. It may be suggested that the time has come when some decision should be sought by international agreement as to the nomenclature and notation to be used in the practical and theoretical aspects of the subject of heat. H. S. A.

The Nature of a Gas. By Prof. Leonard B. Loeb. Pp. x+153. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1931.) 12*s.* 6*d.* net.

THIS monograph is published under the auspices of the National Research Council of America and is the first of a series related to electrical insulation. Gases are utilised as insulators and also occur in insulating materials, and knowledge of their properties is of importance to those responsible for the design and construction of electrical apparatus of all descriptions. The book contains three chapters, the first an introduction describing modern theories of the electrical constitution of atoms and molecules, the second giving an account of the kinetic picture of a gas, and the third dealing with ionisation phenomena.

The first two chapters are concerned mainly with researches already familiar to the physicist, and many readers will turn with special interest to the third chapter in which Prof. Loeb's own work rightly finds a place. Much useful information is here incorporated, but we must confess to some measure of disappointment with the result. This is due in a large measure to the many problems still unsolved in this branch of physics, but in part to the use of terms, such as 'elastic' and 'inelastic' collisions, which are not adequately defined. As the author points out, too much of the 'how' of the processes described can scarcely be looked for, and we must content ourselves at present with the bare facts.

Vector Analysis : with Applications to Physics. By Prof. Richard Gans. Authorised translation from the sixth German edition by Winifred M. Deans. Pp. ix+163. (London, Glasgow and Bombay : Blackie and Son, Ltd., 1932.) 12*s.* 6*d.* net.

THE special features of this book are the emphasis laid upon the applications of the subject and the forty-four examples with their full solutions (occupying fourteen pages) in an appendix. The first chapter deals with scalar and vector products and their applications, chiefly to electric circuits. The second introduces differential operations ; after defining gradient, divergence and curl we are given many applications to mechanics and physics. An interesting historical note points out that the symbol like an inverted delta was first introduced by Hamilton, who called it "nabla", after a Hebrew stringed instrument. The third chapter deals with orthogonal curvilinear co-ordinates, with applications to Laplace's equation, wave motion, and rigid dynamics. The fourth chapter, headed "Tensors", is disappointing. It opens well by following the historical development of the subject, which is connected with elasticity, but it is misleading to state that "A tensor is determined by six numbers", and the whole of the chapter seems spoilt by the implicit assumption that all tensors are necessarily of the second order and in three dimensions. The fifth and last chapter deals with applications to hydrodynamics and electrodynamics. Except for the tensor chapter, the book appears likely to be useful to students of applied mathematics and physics.

Leçons sur la géométrie projective complexe. Par Prof. E. Cartan. D'Après des notes recueillies et rédigées par F. Marty. (Cahiers scientifiques, Fascicule 10.) Pp. vii+325. (Paris: Gauthier-Villars et Cie, 1931.) 80 francs.

IMAGINARY elements in geometry were for a long time considered solely as an auxiliary to the study of real points. Projective complex geometry, considered as an independent branch of mathematics, owes its origin to von Staudt (1858) who introduced the notion of a chain, and it was greatly developed by Juel (1885) and Segre (1889). The latter showed the importance of *antiprojective* transformations, *anti-involutions* and *antipolarities*. Prof. Cartan treats complex projective geometry from a higher point of view, linking it with non-Euclidean geometry of three dimensions, following the example of Poincaré, who linked real projective geometry with non-Euclidean geometry of the plane.

The first part of the book is restricted to the projective geometry of the complex line and its relations with the geometry of Lobatchewsky. The second part deals with the complex projective geometry of three dimensions. The last chapter treats of the harmonic polynomials of complex projective space and their applications to the representation of this space, or rather of Hermitian elliptic space, by real algebraic varieties without singularities contained in a Euclidean space of a suitable number of dimensions. The writing is clear and attractive, and the book is a useful exposition of one of the less-known branches of geometry. H. T. H. P.

Miscellany

This World First. By J. H. Curle. Pp. v + 212. (London: Methuen and Co. Ltd., 1932.) 6*s.* net.

MR. CURLE is like the road-mender who, when accused of pessimism, said "I ain't no pessimist; I thinks badly o' most things and most people—that's all." Mr. Curle declares himself to be no pessimist; but he sees the world as a series of problems or riddles. Thus: Nature, on one hand a thing of beauty and perfection, on the other is "a spectacle of overwhelming cruelty and horror", which makes "the idea of a Living, Personal God" behind it "a nightmare" and unthinkable; Christianity is dying after nearly two thousand years; Western civilisation is nearly at an end; and science "deeply enheartening when we think of genetics, psychology, bio-chemistry, and medicine; deeply disconcerting when we think of aspects of relativity, of physics, of bacteriology, of poison gas, of weapons of war". We need pursue the list no further. The problems are such as present themselves to all who are not content with a blind acceptance of things as they are, and a familiar symptom of the questioning spirit, which for our good, if not for our comfort, has been all pervasive since the War.

Mr. Curle has travelled widely and pondered his many and varied experiences. As the result he sees a way of escape from pessimism on the line he has suggested in the title of his book: "This World First". If we may no longer look for the intervention of a personal God in the arena of the struggle between good and evil, which we call the world, man must take up the cudgels on his own behalf. Holding fast to the beauty of the world, he must co-operate with law and order in Nature against cruelty and oppression; he must fight on the side of science for the betterment of mankind in the war against degeneracy and disease. Mr. Curle thus sees the solution of his problems in the form of a duty of us all to make secure and hold the good against the encroachment of evil. If this does not help us "to grasp the sorry scheme of things entire", it is at least a sound enough practical philosophy for a work-a-day world which is content to leave the riddle of the universe to solve itself while it "gets on with the job".

Astronomische Paradoxa. Von Dr. Georg Alter. Pp. 72. (Prag: J. G. Calve'schen Universitäts-Buchhandlung, 1932.) 25 Kč.

THIS work is a series of short essays explaining a number of points that often cause perplexity to students of astronomy. The earlier ones are elementary; why the sun is not on the meridian at 12 o'clock; why the moon's orbit is concave to the sun, though it revolves round the earth; why it is winter when the earth is nearest to the sun. The following ones are more difficult; why the crest of the tidal wave lags behind the moon; the effect of the earth's rotation on the motion of projectiles, etc.

Chap. viii explains why the effect of a resisting medium is to shorten the time of revolution, although it reduces the initial speed of the body. Chap. ix deals with the Einstein bending of light by the sun, and explains why the star's image is pushed outwards though the light rays are bent inwards. The final chapter explains why the variation oval of the moon is pushed inwards at full and new moon, though these are the points where the outward perturbing forces are strongest; this is a cause of perplexity to many. The author's explanation would not be clear to the 'man in the street', as it needs a considerable knowledge of dynamics.

Some of the problems dealt with are explained in nearly all astronomical primers; but the explanations in this book are fuller and more rigorous than those often given. The mere fact of a result seeming bizarre and unexpected often attracts the attention of earnest students.

A. C. D. C.

Fractures. By Meurice Sinclair. (Modern Surgical Monographs.) Pp. xxxiv + 550. (London: Constable and Co. Ltd., 1931.) 24*s.* net.

THE exceptionally vast and various experience of the treatment of fractured bones provided by the War was responsible for bringing this, like many other departments of applied science, to a

high pitch of efficiency. The author of the treatise under notice, who gives a comprehensive and lucid account of what was learned during those years of strict discipline, complains that in spite of the ever-increasing incidence of traffic and road accidents, there is a widespread tendency to relax the thoroughness of remedial measures, which the War taught surgeons to regard as vital and essential in this department of treatment, so vastly important not only from an æsthetic point of view but also even more so for its economic and utilitarian bearings.

Hence Mr. Sinclair has written this excellent book as an appeal for increased efficiency and care in treating fractures and as a guide for surgeons to the methods that are essential for attaining the best results in practice. It is illustrated with 337 X-ray photographs and diagrams and should become the means of instructing every medical student how to deal with fractured bones.

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Letters to the Editor

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An Egyptian Axe Head of Great Antiquity

IN NATURE of April 18, 1931, I described the investigation of an Egyptian axe head of date 1800 B.C., supplied to me by Mr. Guy Brunton, and showed how it was possible to reproduce it by the ordinary laboratory methods of to-day. Recently, at his request, I have examined an axe head which is many years older. It was found by Mr. Brunton last winter during his excavations at El Matmar south of Assiut in middle Egypt. He informs me that it can be well dated to what is known as the middle Pre-Dynastic period and early in that; that is, roughly about 4000 B.C. He adds: "I know of no other copper implements anything like as early as this with the exception of small pins and such-like; consequently it has a very considerable importance."

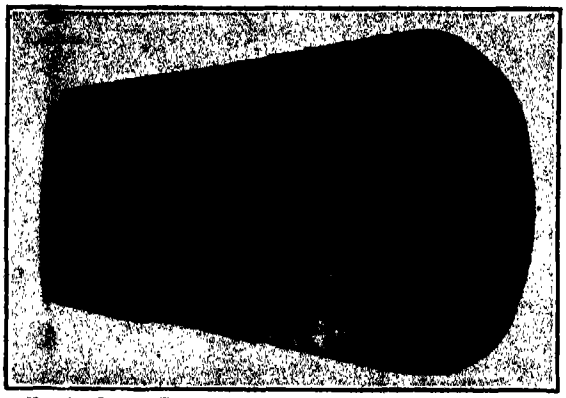

FIG. 1. Middle Pre-Dynastic axe head from Middle Egypt. Reduced by 3/5.

The axe weighed 3 lb. 7 oz. One side of it, reduced by three-fifths, is shown in Fig. 1. It was coated with a thick patina of malachite and azurite with some patches of sandy material adhering to it. Part of one side of the axe was ground and polished; the area so treated is outlined in the top right-hand corner of Fig. 6. Under the coating of carbonate was a layer of cuprite, beneath which was the original copper-coloured metal, apparently sound. When the exposed metal had been polished and examined with the microscope it was found to be differentially corroded, the corrosion product (cuprite) forming a dendritic structure which suggested at once that the metal was a cast alloy with a 'cored' structure. This was confirmed by etching the surface with ammonia and hydrogen peroxide. The structure developed in this way is shown in Fig. 2 at 100 diameters, in which the black corrosion product is seen to coincide with the dark 'cores'.

To reveal the structure of the metal more clearly, the surface was ground to the depth of about one-tenth of an inch, which was sufficient to remove the superficial layer of partly corroded metal. The microstructure of the metal at a point corresponding to *A* in Fig. 6, is shown in Fig. 3 at a magnification of 100 diameters. As is mentioned above, its 'cored' structure indicates that it is a casting of high copper content. Superimposed on the 'coring', however, is a granular twinned structure which shows that the alloy has recrystallised under the influence of strain and heat. This structure could be produced either by hammering the casting cold and then annealing it at a moderately high temperature—the persistence of the coring indicates that the annealing temperature

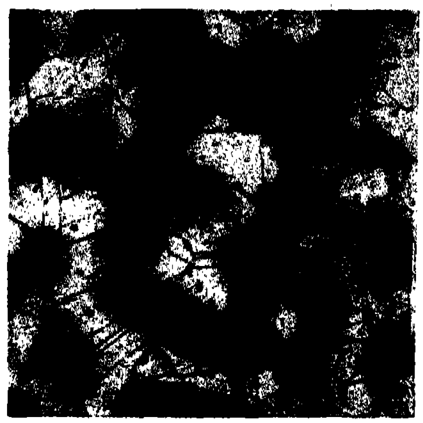

FIG. 2. Microstructure of metal beneath corrosion products. ×100.

could not have been above, say, 800° C., or by hammering the metal hot. Some of the grains in this micrograph contain striations which show that the axe has been cold worked after the recrystallisation occurred. The effect of this mechanical treatment is shown more clearly at a magnification of 200 diameters in Fig. 4 which reveals, in addition to the strain markings, considerable distortion of the twin bands. Near the cutting edge of the axe, the distortion of the metal was much more pronounced

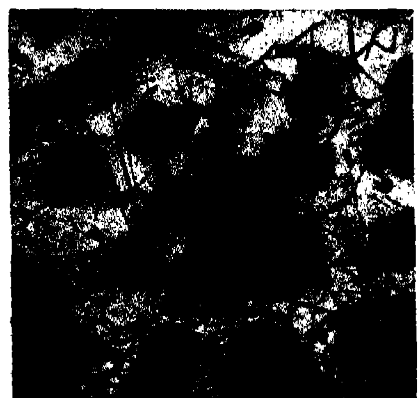

FIG. 3. Microstructure below superficial layer. ×100.

than elsewhere, as is shown by a comparison of Fig. 5 at 100 diameters, which represents the structure at point *B* in Fig. 6, with Fig. 3. This indicates that the axe had been more heavily worked at the edge and suggests that the purpose of the final cold working was to harden the metal.

Drillings for analysis were taken from one of the side edges of the axe head. The main constituents found and their percentages were as follows: copper, 97·35 per cent, nickel 1·28 per cent and

arsenic 0·49 per cent. Metals present in smaller quantities were, lead 0·17 per cent, iron 0·15 per cent and manganese 0·06 per cent. In addition traces of tin and antimony were detected. There remains about 0·5 per cent to account for. This consisted almost entirely of the oxygen present in the corroded products, of which cuprite was the principal. The fact that tin is present only in traces need cause no surprise and is, indeed, to be expected from the great age of the axe head, for as Sebelien

FIG. 4. Microstructure below superficial layer. ×200.

has shown, the Egyptians had not learned how to make bronze until the later dynasties. It is unlikely that any of the elements present in the copper were added intentionally for the purpose of hardening the metal. Almost certainly they were derived from the ores from which the copper was smelted.

Brinell hardness measurements were made at various points on the polished surface of the axe using a 1 mm. ball. The results, which are shown in Fig. 6, were rather irregular, varying from 63 to

FIG. 5. Microstructure at axe edge. ×100.

73 on the flat and increasing considerably near the cutting edge to a maximum figure of 85. The Brinell hardness of an alloy of this composition in the cast or annealed state would be about 50, so it is clear that the axe has been work hardened, no doubt by cold hammering. All the data lead to the conclusion that it was cast roughly to shape and then either cold-hammered and annealed or hammered when hot. After this treatment, which was perhaps a shaping operation, the axe was hardened by hammering it cold, most severely near the edge. In spite of its great antiquity—it is nearly six thousand years old—this axe head has retained a considerable amount of the hardening artificially conferred by work. In this respect it confirms the results of my previous investigation of an axe head about 3,700 years old. The maximum hardness figure is lower, namely, 85, as compared with 112, but the alloys have different compositions and the older axe head is probably rather softer in the annealed state. The Brinell hardness would probably be about 50 as compared with 54. The retention of cold work in alloys of this type may thus be regarded as sufficiently established. Accepting Mr. Brunton's date, it is clear that six thousand years ago, the Egyptians were casting, heat-treating and cold-working copper alloys of these types.

I acknowledge with pleasure the assistance of

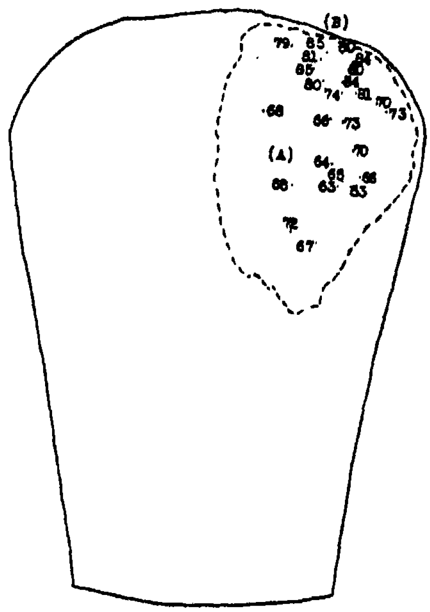

FIG. 6. Outline of axe head and Brinell hardness numbers. The scale of the diagram is one half.

two members of my staff, Mr. C. W. Dannatt and Dr. M. S. Fisher, in the above investigation.

H. C. H. CARPENTER.

Royal School of Mines,
South Kensington, S.W.7,
Sept. 20.

Possible Existence of Multiply Charged Particles of Mass One

THEORETICAL arguments justify the assumption that, while nuclear electrons elude every dynamical treatment, the dynamics of the particles of proton mass in the nuclei is in accord with the general quantum-kinematical scheme.[1] The forces of interaction, however, seem to exceed ordinary Coulomb forces considerably. The binding energy E per particle, for example of a system of two particles of proton mass M in its lowest quantum state, should be for attractive Coulomb forces between the particles:

$$E \sim \frac{Me^4}{8h^2} \sim 6000 \text{ electron volts,}$$

that is, about a thousand times less than the actually

observed binding energy per proton in the α-particle.

On the other hand, the remarkable phenomenon of the anomalous scattering of hard γ-rays cannot be ascribed either to nuclear electrons, because it is known from experimental results concerning the statistical properties of nuclei, that the electrons do not exist in the nucleus as dynamical units, or to proton dipoles, because it is known that the application of the ordinary formula for the scattering coefficient σ:

$$\sigma \sim \frac{8\pi}{3}\left[\frac{e^2}{Mc^2}\;\frac{\nu^2}{\nu_0^2-\nu^2}\right]^2$$

(where ν, ν_0 are the frequencies of the scattered light and of the proton oscillator) leads to intensities of the scattered radiation which are about a thousand times smaller than the observed ones.[3] It should be noted, that in both these cases, where we observe gross and roughly equal departure from simple theoretical formulæ, the formulæ contain the charge in the fourth power.

We know that the constancy of the charge of the particles of mass one is not unlimited: transitions from charge e to zero must occur (proton and neutron). The neutron must not be considered as a diminutive hydrogen atom, but as an elementary particle just like the proton, because of its statistical properties.

Applying this view to the above-mentioned experimental fact, I suggest the following generalising hypothetical assumption: *the particle of mass 1 may have arbitrary, positive and negative (but perhaps only integral) values of its charge.* The stability of a given charge value against β-decay or against its reverse process depends on the quantum state of the particle. In particular it is assumed that a free particle is stable with charge e or zero, an α-particle is stable with charges of about $+6e$ and $-5e$ (in order to explain discrepancies of the order of 1000 in quantities depending on e^4.)

This explains both the strong forces which prevail in the nucleus, and the strong anomalous scattering of hard γ-rays. Virtual forces due to exchange of charge or similar ones can be dispensed with.

The question arises, whether particles in a state of higher charge, if suddenly set free by hard collisions, are sufficiently stable to be observed. With all necessary reserve (because of the uncertainty of the experimental data) I suggest that two phenomena may be interpreted on these grounds:

1. Hoffmann, Steinke and Schindler have observed the production by cosmic rays of secondary particles of high ionising power and kinetic energies certainly greater than 10^8 volts, that is, energies which are great compared with the binding energies of the elementary particles in the nucleus. They suggest that these particles should be complex nuclear fragments. It is, however, necessary to consider, that the nuclear binding forces are negligible compared with the forces which effect such enormous transfers of kinetic energy. In that case only elementary particles can be ejected. I suggest that in these cases particles of mass 1 and of high charge are set free and take some time before arriving at their stable charge value (e or zero). The majority of the rays reported by Steinke and Schindler (those giving 3×10^6 ion pairs) can be ascribed to particles of mass 1 and charge between $5e$ and $6e$.[2]

2. The outstanding difficulty in the interpretation of the experiments on cosmic rays is the fact, that the particles, the distribution of which is only slightly affected by the earth's magnetic field, seem to be absorbed largely in the earth's atmosphere. (The ionisation at 28 km. height is about sixty times bigger than at sea level; in particular, there appears to be absorption already in the first two metres of water-equivalent.) I suggest that the decrease in ionisation in passing downwards from the upper layer of the atmosphere may be due not to a decrease in the number of ionising particles but to a decrease in ionising power, and this in turn to a decrease in the charge. The particles of mass 1 and high *positive* charge may in the interstellar space find no chance to collect electrons for compensating their charge and enter the earth atmosphere in the state into which they were originally dissociated. This assumption could easily be tested by measuring the *number* of particles up to great heights and comparing the results with the variation of *ionisation*. Only the latter has been measured so far.

M. DELBRÜCK.

Wills Physical Laboratory,
University of Bristol,
Sept. 1.

[1] Cf. N. Bohr, Address to the Rome Congress on Nuclear Physics, 1931.
[2] Cf. Gamow, "Constitution of Atomic Nuclei and Radioactivity," Oxford, 1931.
[3] Cf. Bethe, *Z. Phys.*. **76**, p. 293, 1932.

Atmospheric Conditions and the Kennelly-Heaviside Layer

SINCE 1925, I have made observations upon the signal strength of KDKA in Pittsburg. The observing station at Morgantown, West Virginia, is sixty miles due south of KDKA. My results are in complete agreement with the discoveries of Prof. Ivo Ranzi[1], provided I assume that the 309-metre wave from KDKA behaves like a 100-metre wave in so far as the E layer is concerned.

The following quotations from my published articles should be compared with the statements of Prof. Ranzi: "The night signal may be equal to, greater than or less than the day signal. A rising curve (stronger signal) after nightfall indicates cloudy or stormy weather, while a falling curve (weak signal) is likely to be followed by clearing weather".[2] "Weather conditions have a decided effect upon the signals from KDKA. So much so that it is even possible to foretell the weather one day ahead by the form of the fading curve".[3] "When a high pressure area covers both Pittsburgh and Morgantown, the day signal from KDKA is stronger than the night signal; while for a low pressure area, the night signal is stronger. If the storm centre passes to the south of the observing station, the fading curve from a station to the north is no longer reliable."[4]

Apparently these variations depend upon the changes in the E layer. During the day the received signal is made up of two parts: the ground wave and a weak sky wave reflected from the E stratum of the Kennelly-Heaviside layer. If there is a low pressure area to the north of Morgantown, the sky wave increases at night and so the night intensity is greater than that by day; if, on the other hand, a high pressure area lies to the north, the E layer disappears rapidly after nightfall and the night signal drops below the day signal. The changing intensity acts like a barometer in indicating the presence of cyclonic and anticyclonic conditions and so has considerable value in weather forecasting.

With this method of fading curves, our weather

prognostications were about ninety per cent correct for the periods in 1927, 1928, 1929 and 1930 during which it was used. The results in February and March of each year averaged only eighty-five per cent. These observations have been discontinued temporarily on account of a prolonged drouth in this section of the United States.

R. C. COLWELL.

Department of Physics,
West Virginia University,
Sept. 21.

[1] NATURE, 130, 368, Sept. 3, 1932.
[2] *Proc. West Virginia Acad. Sci.* 1929, p. 234.
[3] *Proc. Inst. Radio Eng.*, vol. 17, No. 1, January 1929, p. 143.
[4] *Phys. Rev.* Ser. 2, vol. 37, 1932, p. 464, No. 38.

Post Office Reform

ALL who realise the weaknesses of the present system of 'secretariat' control as practised in the great departments of State will endorse the view expressed in the leading article on Post Office reform in NATURE of October 15, p. 557, where it is stated that the Bridgeman Committee has rendered an important public service by the emphasis it places upon the need for bringing the engineers in the Post Office more effectively into the consideration of matters of policy. As is rightly pointed out, the principles of organisation which the Bridgeman Committee recommends should be applied to the Post Office, call for a wider application; and, for the reasons indicated below, the most valuable result of the Committee's recommendations may ultimately prove to be not so much in the reform of the Post Office as in the reactions on the whole structure of administrative control in the public departments.

There is a feeling in some quarters that the Committee's recommendations, if carried out, will dispose of all legitimate complaints on the part of the technical men in the Post Office. The Engineer-in-Chief (and other heads of departments) would, for the first time, be brought into discussions on matters of policy, as of right and in open council; and the possession of technical knowledge and experience would no longer, in practice, debar the engineers from advancement to purely administrative posts. Actually, however, as is hinted in the article in NATURE, acute controversy is certain to arise on the application in the provinces of the Committee's recommendations. It is indeed not unlikely that the position of the now autonomous engineering staff outside headquarters may be positively worsened if the Report is put into effect as it stands; for it is an integral part of the Committee's proposals that executive responsibility should be taken away from the Secretariat and placed upon 'regional directors'. Post Office and Civil Service tradition being what it is, these posts will naturally fall, in the main, to the senior members of the Post Office staff in the provinces, namely, the so-called 'surveyors', whose vestigial title is of itself sufficient evidence of the course of Post Office evolution as an essentially mail-carrying organisation. By its rejection of the almost time-honoured proposal for separating the administration of the telephones from that of the mails, and by its specific recommendation that the post of 'surveyor' should be re-labelled 'regional director', the Committee has rendered it an almost foregone conclusion that the regional directors will be the surveyors 'writ large'.

It must be remembered that the surveyors as a class have taken little or no part in local telephone administration, which has in practice been left to the superintending engineers and the district managers. The result of applying the Committee's policy of a unified administration for all Post Office services would appear to be, inevitably, that, for perhaps a generation, the provincial control of the telephone service will pass into the hands of those who, however gifted in the administration of the mails, were described by the Select Committee on Telephones of 1922 as "a fifth wheel to the coach" in regard to telephone administration. In short, what the Post Office engineers may gain at headquarters and in occasional admission to the sacred preserves of the Secretariat is likely to be lost in the provinces by their submergence, in company with other telephone staff, in an organisation nurtured in the mails tradition.

For the Bridgeman Committee's reforms to have their full effect in promoting administrative elasticity and rapid development in the telephone service, it would seem to be essential for the telephones to be separated from the mails in accordance with the views expressed by (among others) the Select Committee on the Telephones of 1922, the Chambers of Commerce, and the engineers themselves in the evidence submitted to the Bridgeman Committee through the Institution of Professional Civil Servants. Such a separation, under whatever form of public control, would result in the administration of the telephones by telephone men, technical and non-technical. The Committee, while agreeing that theoretically separation would be the ideal solution, recommends against the proposal in view of the manner in which the mails, telegraphs, and telephones have become interwoven in Post Office administration. It cannot be denied that the difficulties of segregation during the transitional period would be considerable; but, on the other hand, it cannot be questioned that the ultimate advantages accruing from such a policy would be so great that it would be well worth while to face any temporary difficulties that might arise.

F. A. A. MENZLER.

15 Adam St., W.1.

Absence of Mitosis in Tissue Culture and Regeneration in *Helix aspersa*

IN recent work on regeneration in the mantle cavity wall of *Helix aspersa* and on the metamorphoses of pieces of the wall kept in blood,[1] no mitosis has been found. Such cell divisions as occur are amitotic. These can be watched *in vitro*, in the hanging drop preparations.

In *Janella*, L. Plate[2] describes the regeneration of cells lining the breathing tubes as occurring exclusively by amitosis.

Normal mitosis takes place, of course, in the hermaphrodite gland, but so far as I know, in the half-grown and adult snail, amitosis is the only method of cell division in somatic tissues I have examined. Possibly some of the readers of NATURE have a series of *Helix* embryos, and it would be interesting to know whether they can find normal mitosis in the somatic tissues, and up to what age.

J. BRONTË GATENBY.

Zoology Dept., Trinity College,
Dublin, Sept. 29.

[1] NATURE, 128, 1002, Dec. 12, 1931.
[2] *Arch. mikr. Anat.*, 51, 1898.

Occurrence of a Paired Parietal Bone in a Snake

A GENERAL conception of zoologists is that the parietal bones are always fused into a large unpaired bone in Ophidia. During our recent investigation of the skeletal systems of different reptiles we found from an alizarine preparation of transparency that

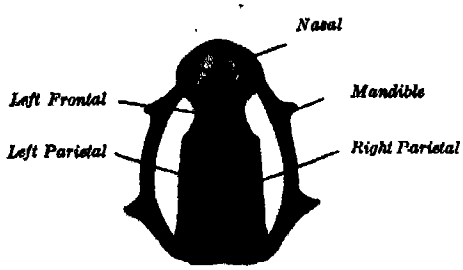

FIG. 1. Dorsal view of the skull of *Typhlops braminus* showing the paired parietal.

Typhlops braminus has a distinct paired parietal bone (Fig. 1). Perhaps their occurrence as such escaped the notice of the former investigators, the size of the skull being very small and alizarine preparation of transparency being unknown to them. The details of the skeletal system will be published elsewhere.

HIMADRI KUMAR MOOKERJEE.
GOPI MOHAN DAS.

University College of Science
and Technology,
Calcutta, Aug. 18.

Prof. P. E. Richards and NATURE

THE letters of the late Prof. Philip Ernest Richards (died June 4, 1920) recently published under the title "Indian Dust" (Allen and Unwin) contain a most interesting reference to the jubilee number of NATURE. Richards was appointed in 1911 professor of English literature to the Dyal Singh College at Lahore, transferring in 1914 to Islamia College in the same town. The letter in question is dated Jan. 23, 1920, and is addressed to his mother:

"The jubilee number of NATURE has fallen into my hands. It presents a portrait of Norman Lockyer, the founder and editor. Here is the man who found something in the sun before it had been found on the earth. Surely a wonderful fellow—far more wonderful than he looks. But I think he looks wonderful. Many articles in the paper review the progress of science in many different branches during the last fifty years. I do not understand one eighth of any article, but I have read them all, and derived a deep sense of satisfaction—joy, I might say. Here are men who have something to live for, and who have much to show for what they have been doing. They are the best sort of men in the world, and the world ought to belong to them, and not to Prussians and Bolsheviks or Indian extremists. But poor humanity is far behind its leaders. Nevertheless, the world is worth living in for the sake of Science—and Literature—and all the other Arts."

T. LL. HUMBERSTONE.

15 Gower Street,
London, W.C.1,
Aug. 25.

Radiographs of Insects

IN a letter to NATURE of Sept. 17, 1932, Dr. Hugo Fricke and Irwin Sizer state, in an account of their own radiographs of insects, that they could not find previous records of such radiographs. We made and published such radiographs five years ago[1,2,3], chiefly with *Deilephila euphorbiæ* pupæ, when carrying out research work on metabolism during metamorphosis of insects. Particulars of the methods used, the results, and about seventy radiographs, can be found in the papers referred to below.

The radiographic method was afterwards found useful in economic entomology, and we have made radiographs of insects for the Department of Sylviculture. The distribution of parasitic hosts in populations of hundreds of pupæ can be shown in one single radiograph without injury, and further development can be observed by the same method.

J. HELLER.
E. MEISELS.

Department of Medical Chemistry,
University of Lwów, Poland.
Sept. 26.

[1] J. Heller und E. Meisels, "Untersuchungen über die Metamorphose der Insekten. VI. Röntgenographische Untersuchungen über den Entwicklungsvorgang." *Biol. Zentralblatt*, **47**. 257-264; 1927.
[2] E. Meisels und J. Heller, "Ueber die röntgenologische Beobachtung der Metamorphose bei Insekten." *Fortschr. a.d. Gebiete der Röntgenstrahlen*, **36**. 104-109; 1927.
[3] J. Heller, "Badania nad przeobrażeniem owadów." *Acta Biol. Exper.*, **2**. 225-315; 1928.

Colonisation of the Sea by Insects

THE letter from Dr. Hem Singh Pruthi on this subject[1] is of much interest, but one feels doubtful whether the comparative absence of insects from the oceans can be accounted for simply on the ground of calcium deficiency. Even supposing that the remarkable instance of the *Clœon* larva, which he cites, is to be connected with the unusually high concentration of calcium in the waters of the Salt Range, there remains the fact that many species of Coleoptera (Dytiscidæ, Hydrophilidæ), as well as Hemiptera (Corixidæ) and Diptera, have been recorded from waters of a salinity equal to or greater than that of the sea, but in which the proportion of calcium was no higher.

Several species of insects which I myself have recorded[2,3] from saline waters, both on the south coast of England and in the desert regions of California, are listed in the accompanying table.

Insect.	Range of Specific Gravity to which exposed.	Locality.
Hemiptera		
Corixa selecta .	1·009–1·035	Sussex, England
Coleoptera		
Octhebius marinus	1·014–1·035	Sussex, England
Octhebius rectus	1·024	Death Valley, California
Philhydrus maritimus	1·009–1·035	Sussex, England
Diptera		
Culicoides nubeculosus	1·022 (circa)	Somerset, England
Ephydra hians	1·024	Death Valley, California
Ephydra riparia	1·026–1·035	Sussex, England
Nemotelus uliginosus	1·000 (?)–1·035	Sussex, England

In each case, although the specific gravity of the water to which the insects were exposed was almost

as great if not greater than that of the sea, analysis showed the proportion of calcium to be definitely lower. In the case of the Californian locality, the amounts of calcium and sodium were 84 and 9010 parts per million respectively, whereas in sea water the amounts in parts per million are approximately 420 and 10,700 for calcium and sodium respectively. Therefore the inability of these and allied forms to colonise the sea itself can scarcely be explained on grounds of calcium deficiency.

Secondly, the Caspian Sea may be cited as an example of a type of lake which, while of a lower total salinity than the ocean, has a much higher proportion of calcium and magnesium salts. Yet insects do not appear to have been strikingly more successful in adapting themselves to saline conditions here than elsewhere.

W. H. Thorpe.

Zoological Laboratory,
Cambridge,
Aug. 29.

[1] Nature, 130, 312, Aug. 27, 1932.
[2] Thorpe, W. H., 1927: "The Fauna of Brackish Pools of the Sussex Coast", *Trans. S.E. Union of Scientific Societies*, 1927, pp. 27-34.
[3] Thorpe, W. H., 1931: "Miscellaneous Records of Insects Inhabiting the Saline Waters of the Californian Desert Regions", *Pan-Pacific Entomologist*, 7, 145-153.

Susceptibility of English *Culex pipiens* L. to Infection with Bird Malaria

In a recent letter[1] we described a method of inducing females of *Culex pipiens* to gorge on canaries. We have utilised this method for experiments on the infection and transmission of bird malaria by English *C. pipiens*. In the course of our experiments 393 mosquitoes gorged on birds heavily infected with malaria (*Plasmodium relictum*, Grassi and Feletti). 131 of the mosquitoes were dissected and 72 (55 per cent) were found to be infected. On dissection many of the mosquitoes showed more than twenty cysts on the stomach and the salivary glands were heavily infected with sporozoites. The infected mosquitoes readily transmitted the malaria parasite to healthy canaries.

So far as we know, there is no published record of the transmission of bird malaria by *Culex pipiens* in England. It is interesting that, once the experimental difficulties of breeding and feeding the English *Culex pipiens* are overcome, it behaves as a normal vector of bird malaria.

P. Tate.
M. Vincent.

The Molteno Institute,
University of Cambridge,
Sept. 29.

[1] Nature, 130, 366, Sept. 3, 1932.

The Vitamin Factor in Dental Caries

Is there not a possibility that the vitamin factor in the production of dental caries is unduly emphasised? That malnutrition may precipitate and intensify decay of the teeth is beyond question, but exception may surely be taken to the inference that if the proper vitamins are present in food all will be well with the teeth. Australian experience is strongly against such an assumption. Here the incidence of caries is admittedly high, but Australia is a land flowing with milk and vitamins; cows are exposed to sunlight throughout the year, whilst fruit and vegetables are abundant, of good quality and cheap.

A distinguished English biochemist, to whom I referred the argument, suggested that the low phosphate content of Australian soils might be the causative factor, but this is easily ruled out, for deficiency in phosphate lowers the yield of food stuff per acre rather than the phosphate content of such food. Anyhow, if low phosphate were its cause one would find this reflected in the growth of bone; and yet twenty-eight years' association with Australian youth has continually aroused in me a deep admiration for his magnificent physique. Are we not dealing with one of those biological degenerations which may overtake any organ and will lead to extinction of such unless selection is kept busy?

Formerly the edentulous human suffered from grave malnutrition, and the girl with pronounced caries was not only physically unattractive but also repellent. The modern excellence of the dentist's art has stopped both forms of selection and so may we not expect human teeth to go the way of the snake's legs?

W. A. Osborne.

University of Melbourne.
Sept. 6.

Further Doublets of As V

While examining the spectra obtained by passing varying discharges through the vapour of pure metallic arsenic contained in capillary tubes, certain lines were found to be even more strongly enhanced than those due to the trebly-ionised atom, with increase in the intensity of excitation. A strong doublet at λλ 2902, 2785 which was completely suppressed by the introduction of the slightest inductance in the circuit was therefore ascribed to the quadruply-ionised atom of arsenic.

Sawyer and Humphreys[1] reported the identification of four pairs forming the first members of the doublet series of As V. The above pair is found to be the combination $5s\ ^2S_1 - 5p\ ^2P_{1,2}$ and is in perfect agreement with the corresponding pairs in the sequence Cu I, Zn II, Ga III, and Ge IV. The value of the term $5s\ ^2S_1$ found by Sawyer and Humphreys ($\nu = 241540$ cm.$^{-1}$) led to the values $\nu = 207096$ and 205648 cm.$^{-1}$ for the $5p\ ^2P_1$ and the $5p\ ^2P_2$ respectively with the difference $5p\ ^2P_1 - 5p\ ^2P_2 = 1448$ cm.$^{-1}$ This identification is further supported by the detection, in exactly the calculated position, of the inverted group $4d\ ^2D - 5p\ ^2P$.

Classification	λ (Int.)	ν (vac.)	δν	ν (calc.)
$5s^2S_1 - 5p^2P_2$	2785·35 (10)	35891·6	1447·2	
$5s^2S_1 - 5p^2P_1$	2902·38 (8)	34444·4		
$4d^2D_2 - 5p^2P_1$	1635·45 (6)	61145		61148
$4d^2D_2 - 5p^2P_2$	1609·16 (6)	62144	1448	62146
$4d^2D_3 - 5p^2P_2$	1597·61 (5)	62593	449	62591

The occurrence of these pairs of As V in a simple discharge tube leads one to think, that, as a method of excitation of spectra, this simple source affords a very wide range of ionisation of the atom, for example, As I to As V.

A. S. Rao.

Science College, Andhra University,
Waltair, India,
Sept. 15.

[1] *Phys. Rev.*, 32, 580; 1928.

Research Items

Buffalo Sacrifice.—The sacrifice of a buffalo at an annual festival in honour of one of the two chief village deities of Manakaddu, Salem City, Madras Presidency, is described by Mr. F. J. Richards in the *Indian Antiquary* for August. The festival is held in February or March in each year and usually lasts for some weeks. The sacrifice here described took place on March 7–8, the seventeenth day of the festival, which had begun on February 19. In the evening the processional images of the two deities, Mâri-amman and Selli-amman, are brought to the temple of Kâli, with whom Selli-amman is identified, and after the sacrifice of a sheep the images of the goddesses are carried in procession around the village, Selli-amman's vehicle being a lion and that of Mâri a horse. In front walks the pariah whose privilege it is to slay the buffalo, carrying the sacrificial knife on his shoulder. His torch-bearer is also a pariah, whose office is hereditary. The goddesses are then carried clockwise around the temple. A plaintive hymn is sung while two men rock the images of each goddess. After the singing of the hymn all females must go home. The buffalo victim is then led to the edge of a pit 50 yards in front of the temple. It must be male. After offerings have been made to the victim by the priest and it has been garlanded and sprinkled with red-ochre, sandal and saffron on the forehead, the pariah awaits the signal that the goddess accepts the victim. This is signified by the shivering of the beast. The victim is held by the people and the pariah severs the neck with two or three blows. The attendant then mixes the blood with boiled rice, which he hands to the executioner, who conveys it to his mouth and then rushes like a madman around the village, at each corner throwing a few grains of blood-sodden rice into the air. The pariahs at the graveside throw the body into the pit, and it must be completely buried before the pariah returns from his circuit of the village. The pariah returns in front of the temple and after a few ecstatic screams, the spirit of the goddess leaves him. The festival closes with the sacrifice of sheep and a general feast on the 8th or 16th day after.

Puebloan Decorative Designs.—The Elden Pueblo, 6½ miles from Flagstaff, Arizona, when excavated by Dr. Walter J. Fewkes in 1926, yielded a variety of pottery, of which the decorative designs have been studied by Dr. Walter Hough (*Smithsonian Misc. Collect.* vol. 87, art. 7). Elden Pueblo is classed as a gray-ware site dating from the 'Great Period' of Kidder and is one of the many of northern type settlements penetrating the Little Colorado area. Band designs and parallel striping are applied in agreement with the structure of the ware, that is, on the corded junctions. Bands did not disappear with the coming of the quadrant art, which is also old and was introduced from the north. Allied to the band are all-over designs made up of a network of interlocking stripes. The quadrant designs seem to mark a profound change in Pueblo cosmogony, which probably began at Elden in Pueblo III. The Elden red-ware takes on the variety of paste and design of the polychrome area of the Little Colorado valley. The whole decorative field of the Elden pottery is elaborated from the bird motive. In its early form it is not realistic, but two engaged spirals generally arising each from a triangular or wedge-shaped base are taken to be the body of the bird. No other symbol is so wide spread in time and space as that derived from the bird. At Elden it occurs in various stages of convention. As a rule two birds are represented in apposition. The most ancient form is curvilinear, expressing motion. The body is sometimes shown as a triangle, sometimes supplied with a head and a tail. The list of small units is not long. Hachuring passed out of use with the discontinuance of gray-ware, about A.D. 1250.

Mammals of Central and South-eastern Asia.—The Kelley-Roosevelt Asiatic Expedition of the Field Museum, Chicago, in a relatively short period in 1928-29, was able to cover a wide extent of territory in central and south-eastern Asia. This was due to the division of the expedition into three sections, each of which touched faunal areas not reached by the others, and the result was a collection of mammals of unusual size, variety and interest. Species are represented from very different regions so that in the systematic account, by Wilfred H. Osgood, which has just been published (*Field Mus. Nat. Hist., Zoo. Series*, vol. 18, No. 10, 1932), inhabitants of the tropical coast of Cochin China rub shoulders with alpines from the highlands of western Szechwan near the Tibetan border. The accounts, however, show that in spite of its temperate climate western China possesses a mammalian fauna many elements of which extend into French Indo-China. To some extent the area covered overlaps that from which the late Oldfield Thomas obtained collections, and the author pays a warm tribute to the co-operation of the scientific staff at the British Museum, in which are housed the type specimens of new forms collected by the French ornithologist, Jean Delacour, whose mammal collections also are described in the Field Museum memoir.

Innervation of the Crustacean Heart.—J. S. Alexandrowicz (*Quart. J. Micr. Sci.*, vol. 75, Pt. 2, pp. 181–249, 3 pls., 1932) gives an account of the innervation of the heart of decapod Crustacea. Three systems of nervous elements can be distinguished: (1) a local system of neurones in the heart itself; (2) nerve fibres connecting the heart with the central nervous system; (3) nerves supplying the valves of the arteries which issue from the heart. The first system consists of a nerve trunk in the dorsal wall of the heart from which branches pass to the muscle-fibres of the heart. The cells in this nerve trunk are of two kinds—large and small—and their number was found to be constant; in *Cancer pagurus*, *Maia squinado* and *Homarus vulgaris*, five large and four small cells were present, but in *Potamobius astacus* there were eight large and eight or may be nine or ten small cells. The cells are multipolar and their long processes (the axons) after sending out short branches (regarded as dendrites) give off long branches to all the muscles of the heart including those of the ostia. The fibres which connect the heart with the central nervous system arise from the subœsophageal ganglion, travel in the nerves which run on the thoracic muscles to the dorsal side of the heart, where they pierce the wall and reach the local system. The thicker fibres, possibly inhibitory, break

up into richly arborising branches forming a neuropile which is the field of conjunction of these fibres with each other and with the neurones of the local system. The nerves of the third system, forming four pairs, arise from the thoracic nerves and innervate the valves of the arteries, except the ophthalmic artery which has a separate nerve from the stomatogastric system. The local system is an autonomic nervous apparatus from which the muscles of the heart receive impulses necessary for their regular contractions; the nerves to the valves bring about contraction of the muscle fibres of the valves during the diastolic period.

Alcohol and Inheritance in Guinea-Pigs.—An extensive experimental investigation of the effects of alcohol on guinea-pigs, made by Miss F. M. Durham and Miss H. M. Woods, has been issued by the Medical Research Council as Special Report No. 168 (London: H.M. Stationery Office, 1932). Prof. Stockard found that treatment of guinea-pigs with alcohol by inhalation led to the appearance of abnormalities which were inherited, also to reduced fertility and higher mortality records. Repetition of these experiments with careful controls leads to negative results, and it is suggested that a smaller amount of green food may have caused a deficiency of vitamins and so produced some of the abnormal offspring in Stockard's experiments. In the present work four successive generations of guinea-pigs were treated with alcohol by inhalation from a half-saturated atmosphere. Ten abnormalities occurred among 6,309 alcoholic stock and one among 674 control stock. There was no evidence that fertility was affected by the alcohol, or that males were more affected than females. A certain decrease in fertility occurred, which is ascribed to genetic qualities in the stock and the effects of inbreeding, but the controls were not extensive enough to prove this point. Some deterioration in weight also occurred, but this, too, may be due to inbreeding. The general conclusion is reached that there is no evidence that alcohol has had a deleterious effect on the genetic behaviour of guinea-pigs, and this is in accord with the results of most other workers.

Management of Race-horse Paddocks.—Prof. J. A. Hanley gives an account of management of race-horse paddocks in the *Student's Gazette* of the Royal Agricultural College, Cirencester, for 1932 (vol. 19, new series, part 1). The type of grass required differs in many respects from that which the farmer wishes to obtain and the methods of management in the two cases must in consequence be different. Paddocks used for exercise, for example, should have a soft springy turf or 'mat', a condition which a farmer would regard as indicating a serious state of deterioration. Owing to the great value of race-horses, oats and bran are fed without stint, and too little attention is often paid to the value of paddocks for grazing. Further, hand feed is apt to be deficient in lime, a danger for which fresh grass is the best natural corrector. To meet the varying needs of the yearlings, breeding mares and foals, and to provide leafy herbage for grazing throughout the greater part of the year, it is evident that a number of paddocks to be used in rotation are needed, and a scheme of management, including manuring, is outlined to show how this may be done. Horses are notably selective in their grazing, so that it is essential to include some other stock (preferably polled bullocks) in the scheme if the grazing is to be of the best quality, and there seems no doubt that the performance of a horse depends in no small degree on the management of the paddocks at the stud where it was reared.

Liquid Inclusions in Minerals.—Most of the known data on the composition and concentration of primary fluid inclusions in minerals is assembled in a paper by W. H. Newhouse in *Economic Geology* for August. Sodium chloride appears to be one of the most abundant and widespread of the constituents present, especially in or adjacent to sulphide ore deposits. It is suggested that the sulphides are carried in solution with sodium chloride and probably at higher temperatures with potassium chloride. The concentration in solutions found in galena and zinc blende from the Mississippi valley ores excludes the possibility of formation by descending meteoric waters. Similar solutions were found in galena from localities where the ores are related to visible igneous rocks (Leadville, Freiberg, etc.), and it is concluded on this evidence that the only known available sources for such concentrated solutions (apart from saline deposits) are magmatic or possibly the first artesian flow from newly tapped beds containing connate waters.

The Elastic Limit of Metals.—Dr. G. Cook describes in the September *Proceedings of the Royal Society* experiments designed to test several rival hypotheses about the stresses necessary to produce elastic breakdown in a metal. The hypotheses which have been suggested include (1) definite shear stress at yielding, (2) definite total strain energy, and (3) definite energy of shear strain. The second hypothesis requires that failure may be produced by superposing a sufficiently large hydrostatic pressure on a constant shear stress which is itself insufficient to cause breakdown, and a direct test led to the rejection of the hypothesis. In the main experiments a triaxial stress, the three components of which could be varied separately, was used instead of the simplified stress systems which have usually been used in work on elastic breakdown. The triaxial stress was obtained by using a hollow steel cylinder exposed to combined axial tension and internal pressure. A large number of samples were tested and analysis of the stresses at breakdown agrees with the assumption that failure takes place when the shearing stress reaches a certain value which agrees rather closely with the limiting stress in simple torsion. A comparison of the limiting stress in simple tension experiments shows some discrepancy, and the author concludes that, while the maximum shear stress is the principal condition of failure, the mode of distribution of the stress has some influence on the yield conditions.

Intensity Distribution in a Band Spectrum.—It is a characteristic of modern spectroscopic theory that it concerns itself with the probabilities of spectral transitions and hence with intensities in spectra. Condon in 1926 gave a theory to explain the general features of the intensity distribution in band systems, but little accurate photometric work has yet been done on band spectra. R. C. Johnson and N. R. Tawde (*Proc. Roy. Soc.*, Sept.) publish a photometric study of the Swan bands of carbon (C_2 molecule). Photometric work over a large range of optical frequencies is very difficult. The method

adopted in the present work is the use of the photographic plate and microphotometer to compare the intensities at the intensity maxima of the (unresolved) bands with the intensity distribution of a calibrated tungsten lamp. The points of technique discussed in the paper are fairly well known to workers in this field. From the observed intensity distribution the transition probabilities are calculated and they agree in a general way with the Condon predictions of the most probable transitions. The experiments with different methods of excitation (bunsen flame, oxy-coal gas flame, argon discharge, and spark under glycerine) show that the populations of the different states do not agree with thermodynamic equilibrium at the temperature of the source.

Water Transport in Electrolysis.—A well-known method for determining the hydration of ions consists in adding to the solution of the electrolyte an indifferent substance such as urea, from the changes in concentration of which around the electrodes it is possible to calculate the amount of water transported by the ions. Experiments by Miss Taylor and Sawyer in 1929 showed that in the electrolysis of sodium chloride, water is transported from the anode to the cathode, the transference per faraday being greater the lower the concentration of the solution. A further investigation by Davies, Hassid and Taylor (*J. Chem. Soc.*, Sept.) extends the results, and it is shown that the transference of water increases with dilution at a rate which is too great to be accounted for by change in the transport number of the ions. It also increases with decrease in temperature, whereas the transport number of the cation decreases with fall in temperature. The calculation of the absolute hydrations of the ions on the assumption that the hydration is independent of the concentration and that the decrease in water transport with concentration depends on the change in transport number, gives impossible values of 240 and 145 molecules of water for the sodium and chlorine ions, respectively. It is concluded that, since activity considerations point to a total ionic hydration which is independent of concentration, the results obtained must be interpreted as indicating that the ions during migration transport a considerable quantity of water with which they are not chemically combined.

Astronomical Topics

Eta Aquilæ and the Cepheid Problem.—Vol. 4, No. 8 of the Publications of Michigan University Observatory contains a study of the spectrum of Eta Aquilæ by Dr. D. W. Lee. The star has been known as a variable since 1784, its period being about 7·2 days. It was soon recognised that the eclipse explanation did not fit this case and many other theories were tried in turn, the one usually accepted at present being Prof. Shapley's pulsation theory. The present paper supports this theory, but with the modification that the pulsations are to a large extent in the star's atmosphere. The spectroheliograph has enabled us to study the behaviour of gases at different heights in the sun's atmosphere, and the experience gained there may be extended to stellar spectra. D. Lee notes that if the pulsation arises from a central impulse, there would be a lag in the phases of the outer layers as compared with the inner ones; his observations confirm this, and indicate the presence of a compressional wave which is traced through four of the lower layers of the atmosphere. A companion paper by W. Carl Rufus in No. 7 of the same publication contains a diagram of the mean velocity curve for all levels. This shows a marked pause in the middle of the ascending portion of the velocity curve. The curves from hydrogen and strontium lines have a secondary maximum at this point. The light-curve has a similar pause, which is supposed to indicate a stage of comparative rest in the atmosphere.

The light maximum follows maximum compression of the body of the star by about one quarter of the period; but the maximum compression of the atmosphere would be later than that of the body, owing to the lag in the outer layers. It is concluded that the atmospheric compression plays a large part in the increase of light.

The Place of the Moon derived from Occultations.—Prof. E. W. Brown succeeded in his attempt to interest a large number of astronomers in the observation of occultations of stars by the moon. The observers are so widely scattered that the risk of bad weather is largely obviated, and a sufficient number of results is obtained every year to give a good value of the mean error of the moon in longitude. There is, however, one point that prevents us from taking the result as giving the absolute error of the moon; this is the fact that Prof. Brown rather discourages the observation of re-appearances of stars, so that practically all the observations are made between new and full moon. He gives as a reason that re-appearances are more difficult to time with accuracy than disappearances; but this difficulty can be overcome with sufficient practice; there would necessarily be fewer re-appearances observed, since the majority of them occur after midnight; this would necessitate some weighting of the results, to obtain the mean error of longitude. The present system cannot be relied on to give the true error of the moon in longitude, for errors in the assumed semidiameter and in the assumed coefficients of the variation and the parallactic inequality are not eliminated. However, the errors from these sources should be the same every year, so we can take the results with confidence as showing how the mean error of longitude is changing from year to year. Prof. Brown and Dr. Dirk Brouwer have published (*Astr. J.*, 970) their discussion of the observations of the year 1930, and also give a preliminary result for 1931. The following table gives the values for different years, with their differences:

Year.	Obs. minus Tab. Long.	Diff.
1927	+6·92″	
		−0·60″
1928	+6·32	
		−0·36
1929	+5·96	
		−0·17
1930	+5·79	
1931	+(5·6) provis.	

They conclude, from the run of the differences, that the error of longitude probably passes a minimum in 1931 or 1932, and will then increase again.

The Early History of the Cell Theory

IT is now generally recognised that Schwann was not the first to discover cells in the body of an animal but he is often regarded as the founder of the theory of the conformity in the elementary structure of plants and animals. In a recent number of the *Anatomischer Anzeiger* Prof. F. K. Studnička shows that Schwann was neither the first to make this suggestion, nor did he really prove it. He has studied the work of all the forerunners of Schwann and has attempted systematically to interpret the significance of their work.

In 1823 H. Milne Edwards came to the conclusion that the small granules ('globules') of 1/300 mm. in diameter, which he found in all the tissues he examined, are of varied origin and in great part mere artefacts. Henry Dutrochet (1824) accepted some of H. Milne Edwards's ideas (he had seen the same globules), but he made a great advance by directing attention to cells in the modern sense, as typified for example in the ganglion cells of *Helix* and *Arion* and the cells in the glands of *Helix*. In his opinion, the globules of Milne Edwards develop into small vesicles, that is, cells. He compared these animal cells not with the 'great' plant cells, but with the small 'cells', found in the walls of the latter, which probably are plastids and starch granules. According to Dutrochet, the difference between the cells of animals and those of plants lies in the fact that in plants they develop much farther than in animals and give origin to large vesicular formations, whereas in animals they retain the globular form. Dutrochet was completely mistaken in describing such 'cells' in animals, because the 'cell' (that is, the cell in plants) of those times conformed to the usual meaning of this word in English. It corresponded to what we call the cell membrane. As is well known, such cells are only exceptionally present in the tissues of animals. Rich, who has dealt with Dutrochet's work more recently (1926), takes into consideration only Dutrochet's conclusions, some of which happen to agree with our modern ideas, but he overlooks the fact that these conclusions were not sufficiently proved and were, therefore, mere speculations. Dutrochet foreshadowed the cell theory but he was not the founder of the latter.

Raspail (1827) distinguished small and large 'globules' (erythrocytes, for example) and 'cells' and pointed out that the latter may assume a very elongated form, for example, muscle, nerve.

H. Milne Edwards's observations of globules in the body of animals had some influence upon contemporary literature, but to Dutrochet's and Raspail's theories of the essential identity of the 'cells' of both plants and animals, no special attention was paid. They were regarded, not quite without justification, as unproved.

In 1835, Purkinje's pupil G. Valentin described 'granules' in the body of an embryo, 'globules' in the chorda dorsalis and 'cells' in the cartilage of the larvæ of the frog. Another pupil of Purkinje, Raschkow, described (1835) cells in the epithelium of the gums and directed attention to the similarity of the latter to the cells of plants. Following on Purkinje's description in 1825 of the vesicula germinativa in the ovum of birds and the discovery by R. Brown, in 1831, of the nucleus in plant cells, these authors also described the existence of the cell nucleus in animal cells, which had not been observed by Dutrochet and Raspail. In 1836, Johannes Müller rediscovered the cells of the chorda and cartilage.

In 1837, Purkinje communicated to a meeting of the German Men of Science and Physicians in Prague a short note on a theory of the conformity in the microscopic structures of plants and animals and directed attention to the differences between them. This was not a cell theory, and even later Purkinje firmly rejected Schwann's cell theory (1839, 1840). The great advance he made, however, was that he no longer attempted like other workers to discover the plant 'cell' in the body of animals. (We must here bear in mind that the 'cell' of Purkinje's contemporaries corresponded to the cell wall or the cell membrane in the modern sense.) Purkinje did not describe 'cells' in animals, but, more correctly, 'granules' (*Körnchen*), quite different from the 'globules' of H. Milne Edwards, and formed by a special vital substance containing a nucleus. For this vital substance, he was the first to use the term 'protoplasma' and he concluded that this substance and not the outer part, or cell membrane as we would call it to-day, formed the essential constituent of the 'granules'.

Studnička has dealt with Purkinje's work in a special paper: "Purkinjes und seiner Schüler Verdienste um die Zelltheorie"[1]. He points out that J. E. Purkinje (professor of physiology in Breslau and from 1851 in Prague) is to be looked upon as one of the founders of experimental physiology and modern histology and microscopical anatomy. He was one of the first to give an account of the methods for the study of the animal tissues and in a series of papers in conjunction with his pupils described in detail the structure of the chief tissues of the animal body. In particular Purkinje and his pupils described the 'granules' in these tissues, which represent the cells of modern histology, and so to this school (of which Valentin was a very prominent member) belongs the distinction of having been the first to recognise the manifold variety of cells in the animal body. The school of Johannes Müller also discovered the cells of the animal tissues independently, but their observations were published later than those of the Purkinje school.

Notwithstanding the advances made by the Purkinje school, Schwann (1838, 1839) in his well-known book (in which he developed his own cellular theory) returned to the views of Wolff, Oken and Dutrochet. For him, the outer part (cell membrane in the modern sense) was the essential constituent of the 'cell' and he attached no special importance to the cell contents. Nevertheless his views came to be widely accepted and quite overshadowed those of Purkinje, the consequence being that his name became associated with that of Schleiden as the joint founder of the cell theory. So far as the completely mistaken theory of cytogenesis which these two writers advocated is concerned, this was no doubt justified; but Schleiden and Schwann are usually regarded as the founders of the cell theory in the modern sense without any qualification. Even Haeckel regarded Schleiden as the first to extend the cell theory to plants but the botanists never paid great attention to Schleiden's erroneous discoveries, and it is, therefore, the more remarkable that to Schleiden alone was attributed such an important part in the history of the histology of animals.

Schwann introduced Schleiden's errors into animal histology, reinforced by one of his own, namely, the idea that new cells originate chiefly between the old cells, not within them. On these mistaken ideas (the wrong definition of the cell and erroneous ideas of cell formation) Schwann built up his theory of the "conformity in the structure and the development of the cells in animals and plants". It remained for Max Schultze to correct, twenty-two years later (1861), the errors of Schwann's theory in the sense of Purkinje's ideas.

J. FLORIAN.

Anat. Anzeiger, 1927, and *Acta Soc. natur.*, Brno, 1927.

The 'Butterfly' Map Projection

THE problem of reducing the sphere to a plane surface has ever been a difficulty. This realisation has led cartographers to adopt the policy of constructing a map for a specific purpose. The most important features which have to be embodied in maps may be classified in three categories: (1) exactness of shape; (2) exactness of area; (3) exactness of relative position. Whichever of these features will be required is decided by the purpose of the map, and when this has been decided a map is constructed on an appropriate projection. The required feature is embodied in the map, the others are ignored, with the result that distortion in some respect is usually apparent.

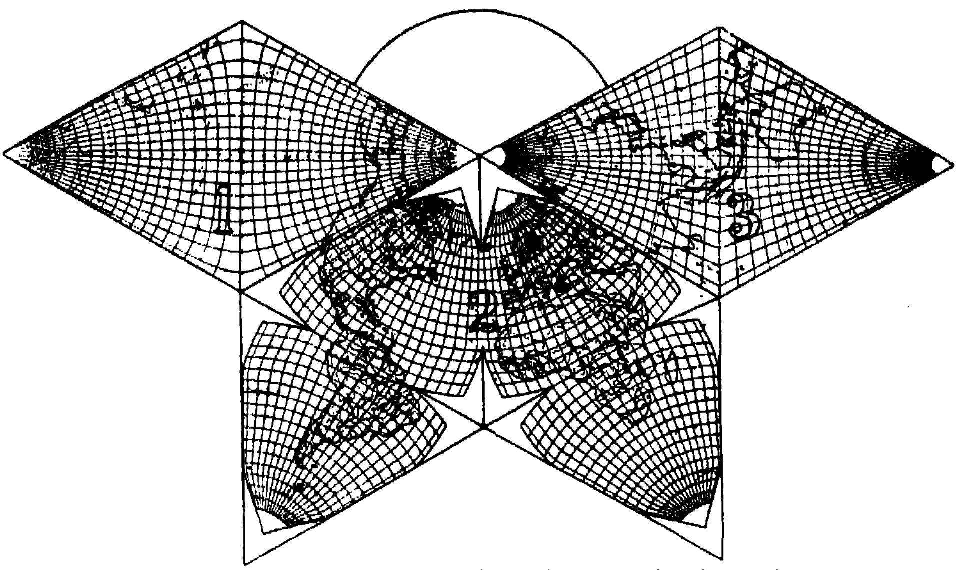

FIG. 1. Butterfly map of the world. The three variants are condensed to one diagram.

Mr. B. J. S. Cahill, of Oakland, California, has regarded this problem from a fresh angle. Instead of making one purpose dictate the form of the whole map, he has realised that in a world map the land areas may be required for one purpose and the water for another. There is also the uneven distribution of land and water over the globe.

The resultant map, constructed to serve many purposes, has been achieved by incorporating various projections into one final form, and by representing the globe by an octahedron (Fig. 1). Such a figure is capable of being more closely approximated to the sphere by the addition, on either face of the octahedron, of smaller tetrahedrons. Thus the principles of triangulation as applied in plane work are translated to the solid. Such an octahedron with tetrahedral modifications can easily be developed into a plane surface.

It must, however, be noticed that such a figure is a substitute for the globe and on development is a spherical representation and not a reproduction. The cube of the gnomonic projection is replaced by this modified octahedron.

The other unusual figure is the combination of various projections, namely, 1, 2 and 3. This gives rise to a grave defect when one remembers that an essential feature of any map is ease of interpretation. A form of projection frequently employed for statistical purposes is that of Mollweide. This is an equal area of projection and when constructed with the Greenwich meridian in the middle of the map, areas in remoter longitudes assume very distorted shapes. To obviate this difficulty the usual form of the projection is replaced by an interrupted form. Against such forms there has always been the accusation that they are not easy to read.

In the case of the 'butterfly' map this criticism will be made, and strongly asserted, because the continuative feature is missing. The faces numbered 2 do not conform to the original octahedral boundaries, whilst the junctions of the portions 1 with 2, 2 with 3 are not too happily made. Such breaches of continuity as are evidenced in tracing the 5° N. latitude and in north-west India (sheets 2 and 3) will require more than supplementing by simple graphic diagrams.

The use of this modified octahedron instead of a single plane is an advantage, but it cannot give a sphere, whilst the discontinuity due to the unhappy alliance of divers projections will scarcely "help mankind to learn to think planetarily".

J. E. COLECLOUGH.

Education and Training for Management

A DISCUSSION arranged by the Department of Industrial Co-operation of the Section of Economic Science and Statistics at the York meeting of the British Association was devoted to the selection, training and placing of administrative personnel, including the study of the "Case Method" as an instrument in education and training for management. The discussion was opened by Mr. Jules Menken, of the Department of Business Administration at the London School of Economics. Mr. Menken described the Case method which was originally developed by the Harvard Business School in the United States. The method is used in many other American schools of business administration as well as at the Business Preparation Centre of the Paris Chamber of Commerce but is little known in Great Britain. Essentially the method consists of the discussion in class of problems actually drawn from business experience. A business case or problem sets forth the facts involved in a particular business situation. It is prepared by the students before they come to class and then forms the basis of a conference or discussion. The student is thus trained to analyse types of business situations, to find principles on which action must be taken in a particular situation, to formulate a plan of action and to justify his policy and plan in reasoned argument.

The successful use of this method depends upon such factors as the selection and training of teaching staff, the development of confidence among the firms associated to secure the provision of material for the cases, and the planning and presentation of the material obtained in a suitable manner. Of fundamental importance is the use of the method with students sufficiently mature in mind and experience to participate in the discussions. The method can be used inductively or deductively but it is relatively unsuited for the teaching of systematised knowledge. Mr. Menken claimed that the method is a valuable instrument for developing a technique of analysis and training the powers of judgment required in business decisions.

The second paper in the discussion was contributed by the Hon. J. F. A. Browne, who outlined some suggestions for co-operation between the universities and industry in the placing of those who have qualified not as specialists such as chemists, engineers, etc., but who have taken a general degree and left the university without a specific vocational qualification. After emphasising the futility of specialised training for business management at the universities, Mr. Browne suggested that it is more important for a man to enter business with a wide general education and a keen mind, trained to learn quickly and accurately, to grasp the essential points of a problem and to analyse a difficult situation. The absence of any agreed demand as to what qualifications are necessary in its recruits, indicates how far industry still is from being professionalised, but industry should regard the universities as a field for recruitment and pay much more attention to machinery for careful and systematic selection of candidates. Bad selection in the past has been largely responsible for much prejudice in industry against university men. Much more of the personal touch is desirable in the work of the Appointments Board particularly in the selection of candidates to be recommended for specified vacancies. Prospective employers should be able to depend on the Appointments Board for a perfectly frank opinion about a man and to regard it as an absolutely reliable source of confidential information. By more careful selection of candidates and particularly by warning them from applying for posts for which they appeared to be unsuitable, the Board could render genuine service to its candidates and prevent the development of an inferiority complex in the minds of those who might otherwise continually apply without success for posts for which they were unsuitable. Efficient selection by the Board, however, depends essentially on industry telling the Appointment Boards frankly what it requires in particular vacancies and in furnishing particulars of the appointment, its duties and prospects comparable in fulness of detail with those supplied by Government regarding Government appointments. Extension of the organised training schemes now being developed by industry is of real value and the Management Research Groups might well explore the possibilities of co-operation in this field, particularly in securing a common approach between different firms and the university appointments boards.

The Wren Tercentenary

THE loan exhibition of portraits, architectural drawings, models, manuscripts, and personal relics illustrative of the life and times of Sir Christopher Wren, brought together in the Trophy Room by the Dean and Chapter of St. Paul's Cathedral, is now open to the public view, and will undoubtedly ensure large attendances, for Wren is secure in the nation's affectionate regard. Very suitably the opening of the exhibition was undertaken by Sir Frederick Gowland Hopkins, president of the Royal Society, who delivered a brief address dealing with various aspects of Wren's many-sided career.

The catalogue of the exhibits contains 168 entries of objects; happily it does not err on the score of meagre description. It would, perhaps, have been helpful to have supplied such an important issue as this—one doubtless destined to circulate all over the world—with a preface embodying the main events of Wren's life, in particular, at least, the series culminating in his great architectural achievement.

Several portraits of Wren at varying ages are shown. These include the small full-length, attributed to Gascar, 1674–80, from Welbeck Abbey, the portrait in the Sheldonian Theatre, Oxford, presumed to be by Sir James Thornhill (about 1675), the St. Paul's modified copy of the Kneller in the National Portrait Gallery (1711), and the Royal Society's portrait, painter uncertain. There is also the Wren death mask, lent by All Souls' College, Oxford. On a sheet of foolscap size appears the following: "I will give one thousand pounds a yeare. Whithall 20 March $\frac{7}{1678}$. Charles R."—

"I will give two hundred pounds a yeare to begin from Midsommer day last past. July 17, 1678 James."

A wealth of material is illustrative of projects and plans for re-building London, its churches, and public offices, under royal commission. Singular in its interest is the great model and rejected design (in oak and other media, and now in complete repair) submitted to the King for a new St. Paul's. A copy is exhibited of Willis's "Anatomy of the Brain" (1664). Though the plates are unsigned they were the work of Wren, as stated by Willis in the preface. It remains to add to this brief notice of some of the many objects displayed that the unique "heir-loom" copy of "Parentalia" (Memoirs of the Family of the Wrens, 1750) is exhibited. This copy descended in the family of Wren, ultimately, by purchase, passing into the ownership of the Royal Institute of British Architects.

From the earliest inception of the Royal Society, and onwards, Wren had been a faithful coadjutor in many ways, a councillor strenuous in effort, prompt in action. On St. Andrew's Day, November 30, 1680, the date of the anniversary meeting (held at Gresham College) for the election of a president and council, it appears that Wren had been re-nominated for membership of council, in company with others. A new incoming member, no other than Robert Boyle, the illustrious philosopher, was chosen as president to follow Sir Joseph Williamson. However, the unexpected happened, for Boyle, in a letter to Robert Hooke, declined office, respectfully desiring the Society to proceed afresh. Whereupon, without any dissentient, Sir Christopher Wren was elected, and he was continued in the post at the anniversary meeting of the year following.

Our existing cordial relations with Sweden are curiously reminiscent of that remote gathering. It is recorded that whilst the lists were being collected, M. Lyenbergh, envoy from the King of Sweden, presented a letter and two books from Dr. Olaus Rudbeck, professor of anatomy at Uppsala, Sweden, for which the president returned the Society's thanks to the envoy. Both communications engaged discussion at a subsequent meeting.

University and Educational Intelligence

CAMBRIDGE.—The professor of physiology has, with the approval of the General Board, appointed G. S. Adair, of King's College, an assistant director of physiological research.

The Cavendish professor of experimental physics gives notice that the Clerk Maxwell Scholarship will be vacant in December 1932. Candidates are requested to send in their applications to Lord Rutherford, at the Cavendish Laboratory, on or before November 1.

At Trinity College Mr. H. Davenport and Mr. G. A. Millikan have been elected into fellowships.

ST. ANDREWS.—An extensive addition has been made to the Bute medical buildings in the form of a new block to house the Departments of Botany and Geology, zoology taking over the accommodation vacated by botany. The new building is of stone and has a dignified appearance, combining harmoniously with its surroundings. The ground floor is occupied by the Botany Department and comprises a lecture room, which will accommodate seventy students, laboratories, research rooms and herbarium. Above are the classrooms of the Geology Department, together with laboratories for palaeontology, mineralogy and petrology. Excellent facilities are available for research both in the building and in the country round St. Andrews.

The work of the Departments of Chemistry and Natural Philosophy was handicapped last session on account of the fire on November 3. Reconstruction and alteration have now been completed, and improvements have been made in the physical and chemical laboratories. A good-sized honours laboratory has been provided at the top of the main staircase for students of physics, and the accommodation for physical chemistry has been much improved. Mr. Donald Mills was the architect for all these buildings.

RESEARCH in higher education is recognised and encouraged by the United States Office of Education as of fundamental importance at the present time and the first of a series of official bulletins on the subject has recently been issued by the Government Printing Office. This reproduces eleven papers read at a conference held last year under the joint auspices of the Office of Education and the University of Oregon. Some years ago this University instituted an elaborate investigation of the methods by which university teaching might be improved. A five-year experimental programme was prepared and a faculty committee proceeded to carry it out. In the papers now published are summarised some of the results grouped under the headings "Instruments of Measurement" (for example, marking systems and types of examination), "Student Personnel Studies" and "Administrative Measures Based on Test Results". Under the second of these are included some interesting accounts of "orientation" and "how-to-study" courses designed as safeguards against the waste of time and discouragement which, in the absence of a tutorial system, are too often experienced by students on passing from school to university, while they are adjusting themselves to the changed conditions of life and study. Such courses, consisting mainly of assigned reading, discussion, some lectures with drill in note-taking, and a large amount of specific drill in approved methods of study and economies in the use of time, have been provided at Oregon since 1927 and their results have been carefully watched and evaluated both subjectively (collecting students' opinions) and objectively—by comparing academic records of students who had participated in the course with those of 'control' groups who had not.

Calendar of Geographical Exploration

Oct. 25, 1616 —West Coast of Australia

Dirk Hartogszoon reached the island still known as Dirk Hartog Island and sailed northward along the west coast of Australia from $26\frac{1}{2}°$ to 23° S. In 1696 de Vlamingh, in the course of an important survey of the coast, during which the islands fringing Shark's Bay were discovered, found a pewter plate set up by Hartog on his visit. De Vlamingh also visited the Swan River, so named from its black swans.

Oct. 26, 1776.—South-west United States

Two Franciscan friars, Fathers Escalante and Dominguez, reached the Colorado River on their return from a journey begun in Santa Fé in July. They set out with the aim of opening up an overland route from northern Mexico to the Pacific seaboard.

They failed in this, but their journey was the most important achievement in the south-west of what is now the United States until the beginning of the nineteenth century. From Santa Fé they went north-west, crossing the upper Rio Grande and entering the basin of the Colorado. They reached the head waters of the San Juan, its eastern tributary, crossed the plateau region between it and the upper Colorado and traced part of the course of the Rio Dolores. They visited the Yuta (Utah) Indians and arrived in the territory of the Comanche Indians after crossing the Green River. A difficult mountain traverse brought them to Utah Lake, which discharges northwards into the Great Salt Lake. This journey marks the farthest advance of the Spaniards in the interior of North America; it was not followed up, fur hunters and adventurers from the United States being the first to make their way into the region of the Great Salt Lake. Escalante's narrative gave useful information about the climate, products and peoples of the region.

Oct. 29, 1762.—Niebuhr in Yemen

A party of Danish scientific workers, among whom was Carsten Niebuhr, a mathematician and practical surveyor, arrived at Jidda in a pilgrim ship. There they remained for two months before they could get a barque to take them on to Yemen, and they passed the time in making observations on the country inland. The party broke up at Beit el-Fakih, and between them covered most of the Tehema southwards to Tais and Zebid and the lower mountains. They were able to travel unmolested in a country afterwards noted for its fanaticism until they reached Mokha. Three of them reached Sana in July, 1763, but they were ill, and two had died; they decided to return, two of them dying on the voyage. Niebuhr was in Arabia again in 1765. Sana, his farthest point inland, is less than a hundred miles from the Red Sea coast, and he explored but a small region. Yet the insight he showed and the careful and faithful delineation of what he saw have made his work a classic still valuable to the student and would-be traveller in the Yemen.

Societies and Academies

London

Society of Public Analysts, Oct. 5.—E. Hinks: Third report of the Milk Products Sub-Committee: The analysis of sweetened condensed milk in which the sucrose has altered during storage. The problem was at first thought to be one merely of determining invert sugar, but by the study of 'aged' sweetened condensed milk by various processes, a modified Barfoed process, copper reduction processes, and in particular a combination of the polarimetric and chloramine-T-iodide oxidation, it was found that the usual hydrolysis products of sucrose present, if any, were dextrose, lævulose and lævan, the proportion of dextrose being sometimes as high as nine or ten times that of lævulose.—**E. B. Hughes**: A new copper reagent for sugar determinations. This reagent consists of copper acetate (5 gm.) mixed with triethanolamine (5 gm.) and made up with water to 100 c.c. The reagent has selective reducing properties; its action on dextrose is appreciable; its action on lævulose is very much greater, and it is only negligibly active towards sucrose, lactose and maltose. By modifying the formula (also by purifying the triethanolamine) the reagent can be made to react strongly with lævulose, but not to oxidise dextrose.—**W. G. Moffitt**: A colorimetric method for the determination of chloroform. The blue colour reactions given by chloroform with α- or β-naphthol in a strong solution of sodium hydroxide have been made the basis of a rapid colorimetric method of determining chloroform. None of the seven chloro compounds tried (including carbon tetrachloride) was found to have any appreciable influence on the reaction with β-naphthol, although α-naphthol gives a blue coloration with carbon tetrachloride under the conditions of the test.

Melbourne

Royal Society of Victoria, Aug. 11.—Leo W. Stach: Victorian Tertiary Polyzoa. (2)—Catenicellidæ. A review of this typically Australian group of the Polyzoa and a suggested new subdivision into three subfamilies, based on the position of the ovicell on the zoarium. This paper discusses the new subfamily Vittaticellinæ and correlates ovicelled zooecia described as distinct species with previously described forms.

Rome

Royal National Academy of the Lincei, May 1.—G. Armellini: The increment of the eccentricity in the problem of two bodies of diminishing mass, with applications to the orbits of binary stars. For a system consisting of a satellite and a principal star, it has been shown that, if the mass of the system is a decreasing function of the time, the mean orbital distance is an increasing function of the time. Some authors consider that, under these conditions, the eccentricity remains virtually constant, but it is now shown that this view is inaccurate.—**U. Broggi**: Series of factorials and equations to the differences.—**R. Caccioppoli**: Linear functionals in the field of analytic functions.—**A. Mambriani**: The summability of Fourier's double series of discontinuous functions.—**T. Boggio**: A theorem of Siacci for the motion along a curve.—**A. Consiglio**: A revolving elliptical obstacle invested by an irrotational plane current.—**G. Agamennone**: The reflection of seismic waves at the antipodes as a cause of earthquake shocks. An attempt was made by Oddone in 1907 to prove that seismic waves, generated by a violent earthquake shock, may be propagated along the earth's diameter to be reflected back along their path and thus give rise to a shock of less intensity than that of the original shock; a second such reflection, giving another shock, was also considered possible. Various difficulties involved in such hypothesis are now discussed.—**B. Rossi**: Secondary effects of penetrating corpuscular radiation. In traversing matter, the corpuscles of penetrating radiation generate a secondary radiation, probably also corpuscular. The number of such secondary corpuscles generated in iron is only about one-half of the number generated in lead and is less than would correspond with the ratio between the two densities. The penetration in iron is, however, about three times that in lead, so that the number of secondary rays in equilibrium with the penetrating corpuscular radiation should be somewhat greater in iron than in lead.—**B. Rossi and B. Crinò**: Anomalies in the absorption of penetrating radiation. Measurements of the absorption in thin lead screens have been made to show the influence of secondary radiation in experiments carried out by the coincidence method

and to indicate how such influence depends on the position of the absorbing screens.—**F. De Carli**: Compounds of urea with alkaline-earth bromides. The solubility isotherms at 11° of the systems, $CaBr_2—CO(NH_2)_2—H_2O$ and $SrBr_2—CO(NH_2)_2—H_2O$ reveal the formation of the compounds, $CaBr_2$, $4CO(NH_2)_2$, $2H_2O$ and $SrBr_2$, $4CO(NH_2)_2$, $2H_2O$, the existence of which in solution is not, however, shown by measurements of the density and fluidity.—**D. Marotta** and **G. Rosanova**: The structure of C-substituted derivatives of barbituric acid. The formation of barbituric acid and its C-substituted derivatives by condensation of malonic acid and its derivatives with carbodiamide indicates for these compounds the structure $CH_2R_2<\frac{CO\cdot NH}{CO\cdot NH}>CO$. Observations on the metallic derivatives of the compounds and their behaviour on fusion with potassium hydroxide raise a doubt as to the accuracy of this constitution.—**B. Monterosso**: Cirrepedological studies (7). Euryalinity and anabiosis in *Chthamalus stellatus* Ranzani. When immersed in fresh water, *C. stellatus depressus* survives for four months at the most and undergoes a partial crisis in its motor activity, but there is no arrest in the relative function and no assumption of a hypnic state (Kreps' *Salzschlaf*).—**M. Sacchetti**: Certain *Zygosaccharomyces*. Copulating yeasts appear to be widely diffused in Nature and a number have been isolated from various Italian products. None of these could be made to sporulate by Hansen's method, but all sporulated on the upper portion of streak cultures on agar or gelatine. To two new species the names *Zygosaccharomyces gracilis italicus* and *Z. felsineus* are given.—**Federico Millosevich**: Obituary notice of Ferruccio Zambonini.

SYDNEY

Royal Society of New South Wales, July 6.—**A. R. Penfold** and **F. R. Morrison**: The occurrence of a number of varieties of *Eucalyptus radiata* (*E. numerosa*) as determined by chemical analysis of the essential oils (1). The several physiological forms of this plant cannot be distinguished on morphological evidence but are readily differentiated by the variation in the chemical composition of the essential oils. The forms can also be separated in the field by crushing the leaves and noting the odours. The chemical evidence in support of the physiological forms is taken from the following data: specific gravity, optical rotation, refractive index at 20° C., composition.—**H. G. Raggatt** and **H. F. Whitworth**: The intrusive igneous rocks of the Muswellbrook—Singleton District. (2) The Savoy Sill, with rock analysis by **W. A. Greig**. This paper describes a large sill-like mass of Tertiary age which intrudes the Greta Coal Measures near Muswellbrook. The intrusion is shown to be a composite sill, the feeding channel of which appears to be partly exposed. The occurrence of two rock types is recognised, one analcite dolerite, and the other soda syenite. An analysis of each of these two types is given and their relationship to each other discussed both from the point of view of petrology and tectonic geology.—**Francis P. Dwyer** and **David P. Mellor**: The crystal structure of indium. While earlier goniometric studies made on electrodeposited crystals of indium have resulted in their assignment to the cubic system, the lines of a powder photograph made with an impure sample of indium have been interpreted as arising from a face-centred tetragonal structure. In order to check the former observations, powder photographs have been made with carefully purified indium deposited on fine silver wires under different conditions of temperature and current density. In none of the photographs was there any indication of a pattern which could be attributed to a cubic space lattice. The face-centred tetragonal structure of Hull was confirmed. The constants found for the lattice were: $a_0 = 4\cdot587$ (0·002A.), $c_0 = 4\cdot954$ (0·002A.), $a:c = 1\cdot078$.

VIENNA

Academy of Sciences, June 23.—**Anton Kailan** and **Rudolf Raff**: Velocities of esterification of alcohols in acetic acid. Velocity constants, and their dependence on the structure of the alcohol, etc., have been determined for the esterification of a number of alcohols by acetic acid.—**Guido Machek**: Action of gaseous cyanogen on phenols (1): Dicyanogen and the three dihydroxybenzenes. Pyrocatechol yields a cyano-derivative, which may be acetylated, benzoylated and methylated, but resorcinol and quinol yield equimolecular additive compounds with dicyanogen.—**Fritz Rieder** and **Elisabeth Rona**: The ranges of the α-rays of actinium products, RdAc, show, besides the main groups with ranges of 4·6 cm. and 4·25 cm., also groups of less intensity with the values 4·5, 4·2, and 4·1 cm. respectively. Ac X shows groups with the ranges 4·0 and 4·55 cm., as well as the principal group (4·2), and Ac C, the two known groups (4·9, 5·39). With Ac Em, the recently discovered subsidiary group (5·2) and a distinct double character of the principal group are noted. Ac A also exhibits signs of complexity (3 groups).—**Gerhard Kirsch** and **Fritz Rieder**: The neutron emission of beryllium. Investigation of the excitation of the beryllium nucleus to emit neutrons by the Wilson method shows that this is a resonance process, which can be brought about by α-particles with ranges of 35·4, 30·0, 25·3, and about 15 mm. From consideration of the absorption curves it appears necessary to assume that emission of neutrons occurs preferably in the direction of impact of the α-particles and in the opposite direction.—**Marietta Blau** and **Herta Wambacher**: The behaviour of a granule-free emulsion towards α-particles. The blackening of such an emulsion by α-particles follows laws different from those holding for the blackening of ordinary photographic films.—**Walter Späth**: Spectrographic detection of very small quantities of substance. The smallest quantities (in grams) detectable are, by the spark method: 10^{-10} Cd, 10^{-10} Mn, 10^{-7} As, 10^{-7} Te, 10^{-8} Tl, 10^{-11} Sr and 10^{-9} Li, and by the arc method, 10^{-10} Cd, 10^{-9} Te, 10^{-9} Tl and 10^{-8} Mn.—**Roman Lucerna**: History of the development of the Matterhorn (4482 metres).—**H. K. Barrenscheen** and **Johannes Pany**: The rôle of phosphation in the intermediate carbohydrate metabolism of plants (2). Assimilating *Elodea canadensis* yields a hexosemonophosphoric acid which belongs to the levulose series but is different from Neuberg's ester. From germinating wheat a phosphated octa-amylose may be isolated and the action of taka-diastase on this also gives a hexosemonophosphoric acid of the levulose series. Partial degradation of an artificially phosphated starch by means of taka-diastase results in a phosphated octa-amylose identical with that derived from seedlings.—**H. K. Barrenscheen**, **Johannes Pany**, and **Robert Berger**: Glycogenolysis. Post-mortem glycogenolysis of the liver does not proceed linearly but follows a stepped curve, analogous to that of the

scission of inorganic phosphate, the coupling of the two processes being thus indicated. The glycogenolysis is accompanied by the appearance of a hexosemonophosphoric acid, the amount of which increases most during the period when the liberation of sugar and phosphate is declining. The hexosemonophosphoric acid isolated from rabbit and dog livers is chemically different both from those previously obtained from biological material and from the artificial products.—H. K. Barrenscheen and Béla Vásárhelyi: Glycosis of the blood (2): Pyrophosphate fraction and glycolysis. Except with pig's blood, the content of pyrophosphate in different bloods increases with the glycolytic power. The whole blood and the erythrocytes, and, to a less extent, the serum and plasma, contain an enzyme which effects the scission of inorganic pyrophosphate and is inhibited by fluoride.—H. K. Barrenscheen and Karl Braun: Glycolysis of the blood (3): Restriction of glycolysis. The pyrophosphate fraction seems to contain an essential part of the co-enzyme effecting glycolysis.—H. K. Barrenscheen, Karl Braun, and Miklos Dreguss: Inhibition of glycolysis and accumulation of methylglyoxal.—H. K. Barrenscheen and Karl Braun: Colour and precipitation reactions of methylglyoxal.—H. K. Barrenscheen and Miklos Dreguss: Colorimetric micro-method for determining methylglyoxal. By separating the bis-hydrazone formed with 2:4-dinitrophenylhydrazine, results accurate to ± 4 per cent are obtainable.—H. K. Barrenscheen, Karl Braun, and Miklos Dreguss: Inhibition of glycolysis and disappearance of methylglyoxal.—H. K. Barrenscheen, Leopold Frey, and Otto Renth: Muscle rigidity and co-enzyme.—H. K. Barrenscheen and Wilhelm Filz: Co-enzyme action (1): Inhibition of glycolysis and liberation of ammonia. The liberation of ammonia appears to be partly responsible for the inactivation of the co-enzyme in glycolysis.—Franz M. Kuen: Oxidation of sugar by atmospheric oxygen and hydrogen peroxide.

Forthcoming Events

TUESDAY, OCT. 25

ROYAL ANTHROPOLOGICAL INSTITUTE.—Dr. P. V. van Stein Callenfels: "Some Early Migrations in the Far East", at 8.30 P.M.

FRIDAY, OCT. 28

INSTITUTION OF CHEMICAL ENGINEERS—(First Hinchley Memorial Lecture).—Mr. H. T. Tizard: "Chemical Engineering and the Aircraft Industry", at 6.30 P.M.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS—(Andrew Laing Memorial Lecture at Bolbec Hall, Newcastle).—Eng. Vice-Admiral Sir Reginald Skelton: "The Work of Andrew Laing", at 7 P.M.

EAST LONDON CHILDREN'S HOSPITAL, SHADWELL.—Sir Buckston Browne: "Lessons to be Learnt from a Study of the Darwin Family", at 8.45 P.M.

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 4: The Flora of the Turloughs, a Preliminary Note. By R. Lloyd Praeger. Pp. 37-45. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Transactions of the Institution of Chemical Engineers. Vol. 9, 1931. Pp. 212. (London.)

Journal of the Society for the Preservation of the Fauna of the Empire. New Series, Part 17. Pp. 62. (Hertford: Stephen Austin and Sons, Ltd.) 2*s*.

The Royal Technical College, Glasgow. Calendar for the One Hundred and Thirty-seventh Session, 1932–1933. Pp. 449+xxiii. (Glasgow.)

Record of the Royal Institution of Great Britain, 1932. Pp. 176. (London: Wm. Clowes and Sons, Ltd.) 5*s*.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 62, January to June. Pp. xxvi+192+14 plates. (London: Francis Edwards, Ltd.) 15*s*. net.

Department of Scientific and Industrial Research. Report of the Building Research Board, with the Report of the Director of Building Research for the Year 1931. Pp. ix+158. (London: H.M. Stationery Office.) 3*s*. net.

Proceedings of the Royal Society of Edinburgh, Session 1931–1932. Vol. 62, Part 3, No. 19: Filial and Fraternal Correlations in Sex-linked Inheritance. By Prof. Lancelot Hogben. Pp. 331–336. 6*d*. Vol. 62, Part 3, No. 20: The Diffusion Coefficients of Bromine-Hydrogen, Bromine-Nitrogen, Bromine-Oxygen, and Bromine-Carbon Dioxide. By Dr. John E. Mackenzie and Dr. Harry W. Melville. Pp. 337–344. 9*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Philosophical Transactions of the Royal Society of London. Series B, Vol. 221, B476: Experiments on the Development of Chick and Duck Embryos, cultivated *in vitro*. By C. H. Waddington. Pp. 179–230+plates 22–28. (London: Harrison and Sons, Ltd.)

The Strangeways Research Laboratory, Cambridge. Report for 1931. Pp. 18. (Cambridge.)

Hull Museum Publications. No. 174: Record of Additions and Activities. By Thomas Sheppard. Pp. 14. No. 175: Hull Shipping Pictures. By Thomas Sheppard. Pp. 23. No. 176: Mill and Engine Models at the Hull Municipal Museums; being an Account of some Historic Industrial Models. Made by W. Marshall. Pp. 27. No. 177: Ancient and Modern Wedgwood, exhibited in the Mortimer Museum, Carr Lane, Hull, July–August, 1932. Pp. 32. (Hull.)

OTHER COUNTRIES

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 29: The Possibility of the Entomological Control of St. John's Wort in Australia. Progress Report. By G. A. Currie and S. Garthside. Pp. 28. Pamphlet No. 30: The Bionomics and Economic Importance of *Thrips imaginis* Bagnall, with Special Reference to its Effect on Apple Production in Australia. By J. W. Evans. Pp. 48+3 plates. (Melbourne: H. J. Green.)

Memoirs of the Punjab Irrigation Research Institute. Vol. 4, No. 1: An Examination of some of the Factors determining the Hydrogen Ion Concentration of Suspensions of Punjab Soils. Part 1: The Effect of Concentration of the Soil Water Suspension. By R. C. Hoon and Dr. E. McKenzie Taylor. Pp. 11. 4 annas; 5*d*. Vol. 4, No. 2: An Examination of some of the Factors determining the Hydrogen Ion Concentration of Suspensions of Punjab Soils. Part 2: The Variation of the Hydrogen Ion Concentration of the Soil Suspensions with Time. By R. C. Hoon and Dr. E. McKenzie Taylor. Pp. 12. 4 annas; 5*d*. Vol. 4, No. 3: The Conductometric Method of Analysis as applied to Soil Survey Work. By R. C. Hoon. Pp. 10+2 plates. 6 annas; 7*d*. (Lahore: Punjab Irrigation Research Institute.)

The Indian Forest Records. Entomology Series, Vol. 17, Part 1: Entomological Investigations on the Spike-Disease of Sandal (*Santalum album* Linn.). Part 1: An Introductory Survey of the Problem. By Cedric Dover. Pp. iii+53. (Calcutta: Government of India Central Publication Branch.) 1 rupee; 1*s*. 9*d*.

Indian Institute of Science, Bangalore. Investigations on the Spike-Disease of Sandal. 5: Report of Progress made during the Quarter ending 31st March, 1932. Edited by Dr. V. Subrahmanyan. Pp. ii+18. (Bangalore.)

CATALOGUES

Wild-Barfield Electric Furnaces for Works and Laboratories. Pp. 20. (London: Wild-Barfield Electric Furnaces, Ltd.)

Microscopes and Accessories. Pp. 112. (London: C. Baker.)

Movable, Focussing Self-sustaining Fittings for all Purposes. Pp. 8. (Hazel Grove, near Stockport: John Dugdill and Co., Ltd.)

Automatic Temperature Control. (List No. T.R.2.) Pp. 32. (London: Negretti and Zambra.)

Patent Pyrometer Controller for Temperatures up to 1400°C (2550°F.) (List No. T.R.7.) Pp. 8. The Negretti and Zambra Sea Surface Temperature Recorder. Pp. 4. (London: Negretti and Zambra.)

Standard Books and Periodicals: a Reference Catalogue for Librarians, Institutions, Scholars and Collectors. (No. 393.) Pp. 154. (Cambridge: W. Heffer and Sons, Ltd.)

Newton's Epidiascopes: High Intensity Model fitted with Special Diffusion Reflectors. Pp. 6. (London: Newton and Co.)

Steel Frame Cable Hangers for Armoured Cables. Pp. 2. (Aston, Birmingham: The Electric Depôt, Ltd.)

X-Ray-Camera. (Ron. 33.) Pp. 2. Electrometer Triode. (Trio. 33) Pp. 2. Glass Double Monochromator. (Specmo. 32.) Pp. 4. (Delft: P. J. Kipp and Zonen.)

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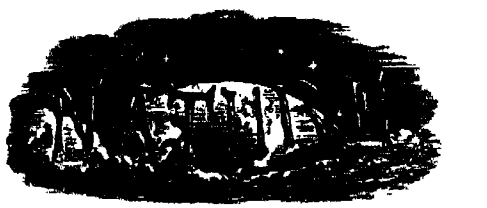

SATURDAY, OCTOBER 29, 1932

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The Patents and Designs Act, 1932

THE new Patents and Designs Act, which comes into force on November 1, represents a serious attempt to remedy some of the outstanding defects of the patent system of Great Britain. The importance of the Act at the present time is due to the close relation, too little understood by politicians and administrators, that exists between invention and unemployment. A good patent system promotes employment by fostering inventions of the 'originative' class, which create new demands and so absorb labour, while it has little effect, one way or the other, on inventions of the 'intensive' class, which cheapen the production of existing commodities and so tend to displace labour. A bad patent system, on the other hand, is a fetter on the limbs of industry and an instrument of blackmail.

The present Act marks a definite advance, and the credit for it must go primarily to the British Science Guild. As the sequel to certain articles that had appeared in NATURE, the Guild appointed a strong committee in April 1927, "to consider what changes could advantageously be made in the British patent law", Dr. W. H. Eccles being chairman and Capt. C. W. Hume, honorary secretary. The report of this Committee, published in October 1928, was very widely discussed, and further reports, based upon it, were prepared on behalf of the General Council of the Bar, a joint committee representing the chemical industry, the Chartered Institute of Patent Agents, and a number of other bodies. In May 1929 the Board of Trade appointed a departmental committee under the chairmanship of Sir Charles Sargant to go into the whole matter, taking the British Science Guild's report as the basis of its discussions. The present Act embodies the findings of the latter Committee, and few pieces of legislation can have been subjected to more extensive expert scrutiny before being passed. Lord Marks remarked at the second reading in the House of Lords : "The bill comes to us from the committee who for sixteen months, with the assistance [*sic*] of the British Science Guild, gave very great attention to this very difficult matter with the object of finding a remedy. Subsequently another committee sat for twenty-six months dealing with the same matter, so that we have in fact a bill which has been, in effect, before a Select Committee for three and a half years."

Whether the new Act achieves a substantial

part of the purpose underlying the British Science Guild's report will depend very largely on the manner in which it is administered. If the Board of Trade is endowed with enterprise and vision, it will seize this opportunity of making British patents the most valuable and trustiest in the world, and so of encouraging the investment of capital under their shelter.

At the very worst, the improvement in efficiency and smooth working entailed by the Act marks a substantial gain. It is unnecessary here to enter fully into the numerous and highly technical changes that have been introduced. In one instance—the remedy against unjustifiable threats based on alleged patent rights—the Act prescribes even stronger remedies than the Guild thought it politic to suggest. Appeals from the Comptroller's decisions will in future go to a High Court judge specially appointed. Nugatory inventions, such as perpetual motion machines, will no longer be patentable. Anomalies and inconveniences arising out of the procedure under the International Convention have been removed. The Act also remedies an important defect that was missed by the Guild's committee—the notorious Section 32 A, which fostered the introduction of absurdly wide claims into specifications. These and many other changes introduced by the Act are definitely to the good.

A more important aim of the British Science Guild, however, and a policy that has always been advocated in these columns, has been to check the grant of invalid patents. In the grant by the Crown of monopolies that are legally invalid lies the root of the most undesirable features of the patent system. The new Act has not dealt very courageously with this problem, but it has allotted to the administration one discretion which, if exercised with vigour and wisdom, will yet make the British patent one of the safest in which a man can invest. The principal source of invalidity in patents is want of novelty. To test the novelty of inventions, the Patent Office has since 1905 made a search amongst British patent specifications, and by doing so it has greatly improved the status of British patents and diminished the facilities afforded to that form of blackmail which depends on the unscrupulous (or unintentional) use of invalid patents. Now, however, for the first time the examiners are given discretion to make a search, like those which are made in Germany and the United States, in technical periodicals, foreign specifications, and other published documents. Will this discretion be exercised, or will the great opportunity afforded by the Act be thrown away?

In the articles in NATURE from which the reform movement originated* it was estimated that a very thorough search of this kind would cost at least £120,000 a year, but it was pointed out that this sum could be provided mainly by the surplus of patent fees which is annually taken away from the Patent Office by the Treasury. Since that date, the annual surplus has risen to between £140,000 and £150,000, and moreover, under the new Act, the application fee is being raised by £1 for each complete specification. The principle underlying the Statute of Monopolies was that it is wrong for the Crown to look upon monopolies as a normal source of revenue. Monopolies for inventions were allowed for the sole reason that they encouraged new manufactures: but the use of them for raising revenue is certainly against the spirit of the constitution. The purpose of the patent system is to encourage inventions, not to raise revenue out of them. The surplus revenue from this source ought to be returned to industry in improved services.

However that may be, the inventor will expect full measure for his additional £1 of fees. He waits with some little anxiety to see how it will be expended. Here is a great opportunity to improve the status of the British patent. Is it appreciated? Will it be seized upon with statesmanlike understanding and foresight? Or will these troublesome men of science, who have clamoured so obstreperously for mysterious improvements relating to the encouragement of invention, be thrown just so much of a dry bone as may serve as an excuse for refusing them a fair meal? It is not unreasonable to feel some perturbation on this point. The recent report on the Post Office shows that British commerce has been prejudiced because Whitehall, having little insight into technical mysteries, could see nothing in the communication services but a possible source of revenue. In mixed metaphor, 'the goose that laid the golden eggs was milked of its last drop of blood.' Now the function of the Patent Office is not to produce revenue but to foster new industries by giving to capitalists and investors a justifiable feeling of confidence in the security of British patents. Will it be deprived, as the Post Office was, of the means for carrying out its new duties efficiently?

* NATURE 116, 121, July 25; 157, Aug. 1; 1925.

Brighter Babies

An Outline for Boys and Girls and their Parents. Edited by Naomi Mitchison. Pp. xi+916. (London: Victor Gollancz, Ltd., 1932.) 8*s*. 6*d*. net.

IF the plethora of encyclopædic outlines published during the past decade is a welcome indication of a growing demand for scientific knowledge, it is doubtful whether it shows a widespread understanding of what the scientific outlook is. It is still more doubtful whether many of their authors are capable of communicating the scientific outlook in the way which Kelvin, Tyndall and some of the foremost expositors of the nineteenth century attempted to do. The prevailing fashion in scientific exposition is to conduct a Cook's tour round the outer and most thinly peopled fringe of the universe of science, leaving the holiday-maker in complete ignorance of the populous cities and well charted roads of the older countries. The practice of doing so has partly arisen because scientific writers who are in a muddle themselves find it helpful to explain their difficulties to a sympathetic and appreciative, if somewhat bewildered, audience. The audience knowing nothing of the vast territory of experimental knowledge which lies behind the proliferation of contemporary hypotheses is fitly impressed. The man of science takes the place of the priest and the successful magician. Kelvin's way was different. His addresses are no spectacular display of the latest and least digested marvels of science. He could be content to select a few of the more homely and firmly established truths of science, leading his audience up to the table and showing them that there is a real rabbit in a quite ordinary hat. As all conjurers know, mystification is more remunerative than straightforward explanation. Publishers have discovered the same truth. For those who enjoy the thrill of being mystified Mrs. Mitchison's collection of contributions from twenty-three authors will provide a powerful magic.

This does not mean that the book is without merit. To avoid confusing the persons it is necessary to divide the substance. Only a third of the book is devoted to natural science. An outline of all human knowledge in nine hundred pages for children and parents alike might conceivably attempt three tasks. One is to communicate to the adolescent what the scientific outlook involves. One is to awaken in the child an intelligent recognition of social obligations. A third and necessary evil, since it is what most publishers prefer to print, is to provide gossip for adults who move in circles where it is fashionable to talk most about what is least understood. The latest undertaking of Messrs. Gollancz strives to fulfil all of these. John Pilley contributes a sensible statement about the nature of scientific laws for those who already know what scientific laws are. Olaf Stapledon discusses (with refreshing sanity) the chaos of a world which is rushing from one financial crisis to another. Dr. Strauss illustrates what he means by psychology with the assistance of a picture in which the human mind is made to look like an iceberg. The illustration is reminiscent of the visions of St. Hildegarde and the text is the spiritual co-twin of the tableau.

Of the three parts into which the book is divided the middle one, dealing with civilisation, is most clearly written for children by writers who have some conception of how much a child of average intelligence can digest. Parents who sympathise with the sane and generous perspective of the contributors will think that the book is well worth buying for the sections by Margaret Cole, Lancelot Beales, Gerald Heard and Olaf Stapledon. Hugh Gateskill is to be congratulated upon having written an intelligible account of money. Those who want their children to grow up with a red blooded 'he-creed' need not be discouraged. They can turn to an earlier article in which eugenics is expounded as the belief that "it would be better if the most successful people had most children". Taken as a whole, the book is too well balanced as a commercial venture to be wrecked by the social intelligence of those who contribute to the second part. The third division illustrates the thesis of some of the articles in the second by showing how intellectuals create the demand for the commodities which they wish to sell.

The first part, which covers the whole of natural science in three hundred and eighty-five pages, raises the greatest expectations. There is no difficulty in deciding which parts are intended for children and which for their parents. The biographical sketches at the beginning of each article are suitable for a backward and ailing child of eight. What follows can sometimes be understood by a university graduate. Among those who have no practical experience of education it is a common delusion that intrinsically

difficult intellectual tasks are somehow facilitated by baby talk. So we read that Richard Hughes "can invent wonderful games. He is rather younger than *me* and has very bright blue eyes" (italics inserted). A few pages later this occurs:

"There are three Pure-Number-Ratios. The simplest is $\frac{M}{m}$: the ratio, that is to say, of the mass of the proton to the mass of the electron (it is about 1,750 times as big). The other two are more complicated: $\frac{2\pi e^2}{hc}$, called the 'fine structure constant', and $\frac{e^2}{GM^2}$ which compares the electric and gravitational forces between two protons."

If scientific knowledge is nothing more than verbal assent to a religious creed or an artistic dogma, the scientific part of Mrs. Mitchison's anthology is above criticism. Parents who live in the suburbs will find in it all the passwords they require, when they visit their relatives in Bloomsbury. If scientific knowledge is an understanding of the path traversed in the process of discovery, it is a monument of educational blunders. It is a verbal statement of the latest conclusions of scientists divorced from the practical basis of any well-established scientific truth. In other words, it magnifies all the defects of science teaching in the school. The chief defects of science teaching at present reside in failure to arrange the subject matter presented in stages adapted to the logical equipment of the learner and failure to adapt the logical technique which the learner acquires in the study of mathematics to the scientific problems which emerge in the laboratory. At present the divorce between symbolism and experience is so grotesque that a constructive educationist would welcome the opportunity of contributing to an outline from which a child might learn good reasons for persevering in some of the apparently useless tasks presented by the school curriculum.

The naturalistic portion begins with an all too short historical survey by Dr. Singer and his wife, followed by two intelligible chapters upon biology. Biology is split into two sections called physiology and biology, as if the latter did not include the former. Chemistry follows. After that there is a section upon mathematics, physics and astronomy treated together. For this order of treatment much might be said. Modern chemistry has some of its roots in the study of respiration. So has the generalised doctrine of the conservation of energy. The study of the constant relation between chemical output and animal heat in the experiments of Laplace and Lavoiser might lead naturally to the search for some measure of mechanical activity with a definite relation to heat production. This opens a safer experimental route to the notion of work than the traditional method employed in teaching mechanics to pupils without a knowledge of the calculus. Adopting this approach, the instructor might be congratulated if a fairly bright child of fifteen succeeded in carrying away a clear understanding of what energy means and why we believe in the atomic structure of matter. Few, if any, with practical experience of education would hope to surpass an achievement so praiseworthy.

The contributors to this "Outline" have other ambitions for their children. These bright babies—bless them—can grasp in two pages that atoms exist. Then they plunge into X-ray analysis and are soon wallowing in "energy-levels". The brighter babies have no difficulty in polishing off energy levels. They already knew all about energy before they read the book. It was not necessary to insult their intelligences by explaining what energy is. So they can trip lightly on to residual forces (p. 296). They reach the Michelson-Morley experiment on p. 314, and pause five pages later to study the implications of Planck's constant. This offers no insuperable obstacle. "John Pilley has told you that the electrons belong in energy levels." Refreshed with a little baby talk they can face the Cepheid variables on p. 335 and digest the Fitzgerald contraction on p. 340. Leaving on one side the Arithmetic Continuum on p. 354, while noting that "π can never be the solution of an algebraic equation", they toy awhile with imaginary numbers. The theory of a complex variable is expounded off on p. 354. After that they are ready to sleep peacefully upon Cantor's unresolved paradox of the last of all transfinite numbers. This takes up the greater part of p. 355.

If this is what the children of the most "successful" people can really understand, there is something to be said for eugenics. A scientific editor equipped with a good knowledge of the history of mathematics and a modest recognition of the fact that education is a skilled job, might have made a constructive contribution of great importance to the task of reforming present methods of science teaching in the school. Instead, the articles

which deal with the physical and mathematical branches of modern science in this outline can only add to the number of children who think that algebra and geometry are mysterious and terrifying branches of poetry with no applications to everyday life. The scientific articles represent a conception of education which is the consistent outcome of an idealistic orientation. For after all, the materialistic outlook, as one much abused philosopher of the nineteenth century remarked, is "the unity of theory and praxis".

LANCELOT HOGBEN.

Elementary Modern Physics

(1) *Electrons and Waves: an Introduction to Atomic Physics*. By Prof. H. Stanley Allen. Pp. viii + 336. (London: Macmillan and Co., Ltd., 1932.) 8*s*. 6*d*.

(2) *Matière et atomes*. Par Prof. A. Berthoud. (Encyclopédie scientifique: Bibliothèque d'histoire et de philosophie des sciences.) Deuxième édition revue et augmentée des "Nouvelles conceptions de la matière et de l'atome". Pp. vii + 324. (Paris: G. Doin et Cie, 1932.) 26 francs.

(1) A SHORT book like this on modern physics, sufficiently technical to make it of use as an introduction to advanced work for a university degree, but easy enough to be comprehensible for more general readers, has been wanted for some time. Its plan is to show the development of those parts of physics which are now of special interest, from ancient times, but to do little more than refer to the older work, and to give quite full accounts of certain aspects of current and recent research. In this way, the interest of the history of the subject has not been entirely lost, but the interconnexions of various parts which have only recently appeared have been kept continually to the foreground

The ground covered is atomicity, relativity, radioactivity, and the old and new quantum theories. The detail presented can be gauged from the index of sixteen pages of small print, but the charm of Prof. Allen's style is such that after reading the book, the fact that it contains so much comes as a surprise. The book is based on lectures delivered in the University of St. Andrews, and the last chapter, a summary of the others, contains the substance of a supplement to NATURE for Dec. 8, 1928. Illustrations are numerous and well-chosen.

One naturally inquires how far Prof. Allen has met in advance the problems which this work presents to a careful reader approaching it for the first time. This he appears to have done unusually well, very largely by introducing a number of apposite quotations from other authors, some of considerable length. In connexion with the general theory of relativity, one notices that the fiction of the freely falling lift has again been employed; this is not an entirely happy illustration, as the process to be visualised is not a common experience, and the whole difficulty with beginners at relativity is, as Prof. Allen realises, to obtain anything more than polite assent to the propositions. Could not the lift be replaced to advantage with something more vivid, for example, a falling aeroplane? In the matter of general presentation, the only criticism which is offered is that perhaps insufficient stress has been put upon the extent to which physics advances through measurements of high precision —in particular, through the accurate work possible with comparatively simple spectroscopic apparatus; some account of, say, H. N. Russell's work on the spectrum of titanium would not have been out of place, and, after all, the process of finding terms in a spectrum has more than a little in common with the solving of cross-word puzzles.

There is a misprint on p. 278, *l* being used for 1 in the table. On p. 193 there is some confusion, not serious, between the different forms of Geiger counters. Philosophers will also certainly quarrel with some of Prof. Allen's remarks and quotations, although to a physicist they are very interesting. These points are, however, trivial, and do not detract from the value of the book, which is likely to be widely read.

(2) The aim of this book is similar to that of "Electrons and Waves". It is the second edition of Prof. Berthoud's "Nouvelles conceptions de la matière et de l'atome" (1923), with a change in title to avoid the implication that it is chiefly concerned with the new quantum mechanics. This is dealt with in an additional chapter, and in all, about half the volume rewritten. Compared with Prof. Allen's book, it covers less ground, but is rather more pretentious mathematically; there is less philosophy, but more space given to the properties of atoms which find expression in the periodic table, as is to be expected with the author a physical chemist. In style, Prof. Berthoud is more dogmatic than Prof. Allen, but still very interesting. The two books can well be read together, and, at the very lowest estimate, Prof. Berthoud's is a good introduction to French scientific literature.

K. G. E.

The Place of Origin of Yellow Fever

Yellow Fever: an Epidemiological and Historical Study of its Place of Origin. By Dr. Henry Rose Carter. Edited by Laura Armistead Carter and Wade Hampton Frost. Pp. xii + 308. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1931.) 26*s*. 6*d*. net.

THE history of yellow fever, notorious for the dramatic suddenness of its outbreaks, and for two centuries an ever-present terror to the crews of old sailing ships, and the coastal towns on both sides of the Atlantic, as might have been expected, has attracted the attention of many writers. Most of these histories, however, were written before the method of transmission of the disease had been discovered; consequently it was very desirable that these earlier accounts of epidemics should be re-examined in the light of more exact information as to the epidemiology of yellow fever. The early history of the disease has now been very carefully investigated by Henry Rose Carter, a well-known authority, who after retiring from the position of assistant surgeon-general in the United States Public Health Service, devoted the last three years of his life to this subject. At his death in 1925, the present work had been fully drafted, but it has been prepared for publication, with some additions, by L. A. Carter and W. H. Frost. The result is a fascinating account of a subject interwoven with the early history of all maritime nations, since yellow fever is essentially a disease of seaports and ships.

The first part of the book is devoted to the epidemiology of the disease, including recent work on the subject; the second part to maladies which have, or might have, been confused with yellow fever in the past; and the third, and greater part of the book, to the place of origin of yellow fever.

Spirochætal jaundice, or Weil's disease, is a serious omission from the long list of diseases that have been confused with yellow fever, since it has been mistaken for this malady up to very recent times, the most notable example of this error being the cases from which Noguchi isolated "*Leptospira icteroides*", the supposed causative agent of yellow fever. It is now clear that these must have been cases of Weil's disease, erroneously diagnosed as yellow fever, since the etiological agent of the latter has been shown to belong to the rapidly increasing group of filterable viruses.

The place of origin of yellow fever resolves itself into a discussion of the rival claims of the only two regions in which it is known to have become permanently endemic—tropical America and West Africa. Although many epidemics have been recorded in western Europe, since the first European outbreak in Cadiz in 1730, there is no evidence that the disease ever became permanently established in this region. The majority of writers in the past, with the notable exceptions of Sir James Kingston Fowler, Sir Robert Boyce and other members of the British West African Yellow Fever Commission, have generally assumed that yellow fever was introduced to the Old World from America, but in recent times evidence has been accumulating to show that West Africa is the original home of the disease. The author discusses the data on this problem under two headings, biological and historical. With regard to the former, it is pointed out that the West African negro possesses a certain tolerance toward the disease, in contrast with the American Indian, who is as susceptible as a white man. The main vector of the disease, *Aëdes* (*Stegomyia*) *aegypti*, has no near American relatives, but many in Africa, a strong argument in support of the view that the yellow fever mosquito was originally an African species, which has been carried in ships to all parts of the world where favourable breeding places and suitable temperatures were present.

The historical evidence is next considered and includes the most interesting chapters of the book. Starting with the assumption that the disease, together with the transmitting mosquitoes, was carried across on ships travelling between West Africa and tropical America, it is shown that a brisk slave trade sprung up between these two regions soon after the discovery of America, for although the first general licence for this trade to the Spanish Indies was not issued (by Charles V) until 1516, already in 1503 the Governor of Hispaniola, Ovando, complained that too many negroes had been admitted for good order. The author then examines the early Mexican records, contained in the hieroglyphic manuscripts or codices, and the writings of the earlier Spanish historians, and shows that, from the symptoms, the epidemics described among the ancient Mexicans could not have been yellow fever, a view supported by the absence of any disease of this nature from the earlier Spanish troops. The Maya records also provide negative evidence for the 120 years previous to 1648, when the first known epidemic of yellow fever in America occurred in Yucatan

and the French Antilles, followed in 1686 by an epidemic in Bahia.

By excluding the presence of yellow fever from America until after 1648, West Africa is considered to be established as the place of origin, but the historical evidence concerning African epidemics is very incomplete. There have not been the same numbers of white settlers in West Africa as in tropical America, and an endemic disease of this nature might well have passed unnoticed among the numerous other diseases.

Nevertheless, the available historical evidence is consistent with the view, also supported by biological evidence, that the original home of yellow fever is West Africa and not tropical America.

E. HINDLE.

Short Reviews

Allen's Commercial Organic Analysis: a Treatise on the Properties, Modes of Analysis, and Proximate Analytical Examination of the various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, etc. Vol. 9: *The Proteins of Plants, the Proteins of Milk, Milk, Milk Products, Meat and Meat Products.* By the Editor and the following Contributors: D. Jordan Lloyd, G. D. Elsdon, H. Leffmann and John Golding, E. R. Bolton, C. Robert Moulton. Editor: Dr. C. Ainsworth Mitchell. Fifth edition, revised and partly rewritten. Pp. ix+617. (London: J. and A. Churchill, 1932.) 32*s*.

IN the previous volumes of this comprehensive work, the general aim has been to deal with separate branches of chemistry in a particular volume. Thus, such subjects as sugars, starches, soaps, explosives, essential oils, etc., require less than one volume each, for their detailed study. The subject of protein analysis, however, receives much wider consideration. The proteins generally have been dealt with in the eighth volume and in the present volume of 600 pages the whole book is given over solely to the examination of proteins of plants, milk and meat. This will necessitate the issue of a new volume for special subjects, such as hæmoglobin, albuminoids, structural proteins, etc.

The detailed and specialised information on protein analysis and related subjects given in the volume under review is more exhaustive and the references more complete, than that in any work of a similar nature hitherto published in English. The most recent methods of analysis are given, especially in the sections on milk and meat products, and special emphasis is placed on methods of practical importance.

The work as a whole is remarkably free from errors and the revision has been thorough and accurate. The high standard of the earlier volumes is being maintained.

J. REILLY.

Comparative Ethnographical Studies. Edited by Erland Nordenskiöld. Vol. 9: *Origin of the Indian Civilizations in South America*, by Erland Nordenskiöld; *An Arrow Poison with Cardiac Effect from the New World*, by C. G. Santesson; *The Ancient Peruvian Abacus*, by Henry Wassén. Pp. iv + 205. (Göteborg: Göteborgs Museum; London: Oxford University Press, 1931.) 18*s*. 6*d*. net.

IN this volume of the "Comparative Ethnographical Studies" the main theme, both in respect of the space it occupies and of significance, is the question of diffusion versus independent origin in America. Baron Nordenskiöld examines the Indian cultures of South America in detail with the view of determining how far they have been introduced *ab extra* and how far they have developed on the spot. By means of tables of geographical distribution, he shows that certain elements—a considerable number in fact—have a sufficiently wide range from the north of North America to the extreme south of the southern half of the continent to be regarded as belonging to a basic Indian culture. The variations in South American Indian cultures are, he holds, developments in response to local conditions, for example, the cultures of the tropical belt. Certain elements are distinctive of American culture and must be regarded as local. Such, for example, are the cultivation of domesticated food-plants peculiar to America, and metal working.

The author sets aside, as outside his province, the resemblances which Dr. Rivet sees between the languages of Melanesia and America; but as regards cultural affinity he argues that any introduction from Oceania must be extremely remote, as it must have preceded the introduction into the Pacific of sugar-cane, the banana, fowls and pigs. The argument is supported by a body of detailed evidence which cannot fail to carry great weight.

The Principles of Epidemiology and the Process of Infection. By Dr. C. O. Stallybrass. Pp. xii + 696. (London: George Routledge and Sons, Ltd., 1931.) 30*s*. net.

THIS book, by the chief assistant medical officer of the City and Port of Liverpool, represents an ambitious effort to link up the observational data of epidemiology as closely as possible with the basic facts and theories of immunological science. It contains nearly seven hundred closely written pages interspersed with numerous charts and tables and displays wide and catholic reading on the part of the author, as the bibliography at the close of the book testifies. The wealth of detail with which certain portions of the book dealing with periodicity in disease, statistical studies and methods of prophylaxis are furnished, will prove most useful to interested readers, as such data are not too readily accessible.

We doubt, however, whether the author was wise in attempting to assemble and evaluate the immunological data appropriate for his purpose without the critical aid that only first-hand know-

ledge and experience of the science of immunology can supply. As they stand, the chapters dealing with the basic data must give a somewhat confused picture to health officers to whom the book is chiefly addressed, and to the bacteriologist some feeling of irritation at the mishandling of his archives. In spite of these faults, the book is a veritable mine of information on epidemiological data of every kind and will, we are sure, prove a highly appreciated work of reference. Misspellings, particularly of proper names, are unfortunately rather numerous.

Airgraphics. By Alexander McAdie. Pp. 37 + 7 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1931.) 12*s.* 6*d.* net.

PROF. MCADIE has brought together a number of physical formulæ and conversion tables of interest to meteorologists. There are also diagrams showing various relationships such as that between temperature and height up to a height of about 25,000 metres in different latitudes in summer and winter. But the value of the work must surely be reduced by the absence of a table of contents and of both preface and index. The absence of a preface makes the task of the reviewer a difficult one, the exact purpose of the work being a matter of conjecture. Matters would not be so unsatisfactory if the diagrams were self-explanatory. Fig. 2 is entitled "Kilobar, Kilograd and Kilometer Scales"; there are three curves labelled "pressure", "density" and "temperature"; these words also appear against the horizontal axis, while "kilometers" appears against the vertical axis. The curve for temperature bears no resemblance to average or individual curves for temperature and height in the earth's atmosphere, which seems to negative the idea that the kilometres are heights. The meaning of the figure is a mystery.

The letterpress begins abruptly on an un-numbered page with a long quotation from Shaw's "Manual of Meteorology", followed by a few comments on this quotation. With the next page a comparatively consecutive narrative begins under the heading "Simplifying Symbols"; suggestions are made as to what symbols should be used in meteorology, and numerous conversion tables and physical formulæ follow. The title of the work is not a good clue to its contents, for whereas eighty per cent of it is occupied with these last items, there is no discussion of graphical methods of presenting upper air relationships and the graphs are its weakest feature. E. V. N.

Constitution of Atomic Nuclei and Radioactivity. By G. Gamow. (The International Series of Monographs on Physics.) Pp. viii + 114. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 10*s.* 6*d.* net.

MR. GAMOW leaves one with a curiously unsatisfied feeling, for in no instance has the quantum theory of the nucleus, his main theme, solved any of the problems encountered with the finality—fictitious, perhaps, but nevertheless apparent—that it has attached to so many other aspects of atoms. The lack of success increases as one moves inwards. Well away from the nucleus, the α-particles and nuclear β-particles and γ-rays are almost old friends with regular habits; the potential barrier which they have to traverse to gain their freedom is also fairly well understood in general terms; but the region within this where they have their origin, which can be studied mainly only by its essentially abnormal conduct when it disintegrates, is largely *terra incognita* still.

Mr. Gamow's book has three principal objects. First, it provides a summary of those results of experiment which are likely to be of the greatest significance in the development of the theory, which proceeds more or less concurrently. In this choice there is naturally a certain amount of individual opinion, but it is doubtful if the selection could have been made better. Evidently much more information is required to test the theory as far even as it has been taken, but it may be confidently expected that recent improvements in technique and the complete working out of the intrusion of optical spectroscopy will provide this before long. Secondly, it develops the initial ideas of Gamow, and of Gurney and Condon, on the properties of the potential barrier, particularly those which are connected with the Geiger-Nuttall law of α-particle ranges; and lastly, and it is here that it is specially important, it contains an examination of the relations likely to exist between the main types of nuclear radiations, both spontaneously and artificially excited, on certain hypotheses, the most fundamental of which is that the extra-nuclear quantum mechanics gives an indication of what may be expected to occur internally.

Mr. Gamow has had the assistance of Miss B. Swirles in the preparation of the English manuscript; the result is a well-written and interesting production, the main faults of which are the absence of an index and of references to other theoretical work.

Microbes and Ultramicrobes: an Account of Bacteria, Viruses and the Bacteriophage. By A. D. Gardner; with an Appendix by G. R. de Beer. (Methuen's Monographs on Biological Subjects.) Pp. viii + 120. (London: Methuen and Co. Ltd., 1931.) 3*s.* 6*d.* net.

DR. GARDNER has added another good biological book to this excellent series. He does not attempt to deal with the whole of microbiology but, after a rather scrappy chapter on the structure and functions of bacteria, he gives good and stimulating accounts of bacterial variation, the ultramicroscopic viruses and the bacteriophage, as up to date as any version of these moving topics can be and adapted for the general biologist as well as the technical specialist. There are a few mistakes; for example, distemper vaccine is not made in guinea-pigs (p. 65). Mr. de Beer adds an appendix pointing out the analogy between genes and viruses.

The Explanation of Animal Behaviour

By REX KNIGHT

PROF. LLOYD MORGAN long ago formulated the principle that "we should not regard any instance of animal behaviour as the outcome of higher mental processes, if it can adequately be interpreted as the outcome of mental processes which stand lower in the order of mental development". This principle is but a special application of the canon of parsimony, which must be obeyed in all scientific explanation; and, when logically extended, it imposes upon us the duty of inquiring, in the first place, whether animal actions must be ascribed to any mental processes at all.

It happens, however, that, if we openly pursue this inquiry, we run the risk of being misunderstood; for many people will wrongly suppose that in suggesting a non-mental explanation of animal behaviour, we are thereby questioning the existence of animal minds. In my much-discussed communication to the British Association at York, for example, I criticised the view that some animal actions cannot be accounted for unless we regard them as caused by the animal's mental experiences; and, in effect, I suggested that the view is unjustified. This was my sole aim, and (since to question whether A is necessary to the explanation of B is not to question whether A exists) it did not imply that there are no animal minds. Moreover, to guard against misunderstanding, I was careful to state, both at the beginning and at the end of my paper, that it is probable, on evolutionary grounds, that animals have mental experiences corresponding to their neural organisation. Nevertheless, I was widely misunderstood, and the general discussion, which newspaper reports of my remarks has aroused, has mostly proceeded on the mistaken assumption that I questioned or denied the existence of animal minds.

Let it be clear, then, that when we inquire whether animal actions can be explained in non-mental terms, the question is not whether animals think, but whether their thoughts must be held to affect some of their actions. What we are asking is this: Even though there be animal minds, must we ascribe causal efficacy to them in order to explain how animals act?

When the layman seeks to produce some animal action, which, in his view, cannot be explained in non-mental terms, he is apt to refer, first of all, to examples of the differentiation that animal behaviour often exhibits. He tells of the cat that will sleep only on one particular cushion, of the dog that attaches itself more to one person than to others, or of some other animal whose behaviour is differentiated. Sir Edward Headlam, for example, wrote to the *Times* (April 5) about a hunter that neighed whenever it saw a pink hunting-coat; and in the same journal (Sept. 24) Mr. H. Boyd Collins told of a dog, which, when its master imperfectly simulated grief, acted in a way in which (so ran the suggestion) it would not have acted if the simulation had been complete. It is urged that in all these cases the animal 'knows', and that its behaviour must be ascribed to conscious discrimination.

This conclusion, however, is unwarranted. The fact that an animal responds differently to two different stimuli may not be due to the animal's having mentally distinguished between them. A wireless set will respond differently to different wave-lengths; a flower will respond differently to light and to darkness; a decapitated earthworm, confined in a T-shaped tube, will keep away from that branch of the T which gives it a mild electric shock; and, if we put a drop of acid on a spinal frog, the brainless creature will scratch just the spot that we touch—and, if we increase the strength of the acid, it will scratch correspondingly harder. Since in none of these cases is there any question of mind, it is clearly illicit to argue that differentiation in behaviour must always be due to conscious discrimination.

A second group of actions, the explanation of which is said to require reference to animal minds, comprises those that are sometimes ascribed to animal memory. Under this head we hear of the cat that purrs when its mistress comes home after a holiday; of the (authentic) elephant that deluged the man who had given it, six weeks before, a sandwich with much cayenne pepper; and of the dogs, referred to by Miss Katherine Buck in the *Morning Post* (Sept. 9) whose death followed, and seemed to be caused by, the previous death of their mate or their master.

But 'memory' is an ambiguous word. We can remember what we did last Sunday, and this kind of memory does involve the mind and conscious recall. We can also remember how to skate or to swim, and here the mind need not enter at all—by saying that we 'remember' we mean merely that the results of certain past behaviour have been enregistered in our bodily system, or (in Pavlovian language) that certain of our inborn reflexes have been interlinked or otherwise conditioned by our environment. Now, no one will dispute that many animal actions are due to memory, in the second, non-mental sense. But can we be reasonably sure that, as Prof. Lloyd Morgan and Sir Arthur Thomson believe, animals enjoy conscious recall? Even if we can be sure of this, are there any animal actions which must be attributed to conscious recall rather than to its physiological counterpart? Clearly, the cat's purring on the return of its mistress demands no such explanation. It can be adequately accounted for by the purely physical traces which the cat's previous association with its mistress has left in its nervous system; and the same may be said of the vindictive elephant. Nor does the death of a dog as the result of the death of its mate or its master need to be ascribed to any mental

experience. After all, a dog will not long survive the absence of food; and, granted that the food-stimulus is one that the dog innately needs, surely the stimuli provided by mate or master may become acquired or conditioned necessities. What affects the bereaved animal may be, not the recollection of past events, but just the absence of the mate or the master from its present environment.

A third group of animal actions, which, it is said, must be due to mental experiences, contains those that arise in connexion with animal learning. Animals, of course, can be trained. Sheep-dogs, horses, elephants, and other animals, are being trained every day; and, under experimental conditions, there has been (to mention only a few examples) the training of Möbius's pike, Yerkes's turtles, Sackett's porcupines, Thorndike's cats, and a large number of colonies of maze-threading rats. But, great as is the practical and theoretical value of animal training, does it anywhere provide us with facts that require the ascription of causal efficacy to animal minds? The training in each case seems clearly to consist in that modification, or conditioning, of the animal's inborn responses which does not demand explanation in other than physiological terms. It exhibits the gradual elimination of wrong responses (wrong in relation to the particular training concerned), and the organisation of right responses into larger and larger units. But it does not necessitate retrospection or any other experience in the animal's mind. There is no need to hold that Pavlov's dogs, when they salivated in response to the ringing of a bell, must have been consciously remembering those earlier occasions when the ringing of the bell had been accompanied by the giving of meat; and all other animal training, being but an extension of this simple case, is similarly explicable in non-mental terms.

Animals, however, do not learn only when they are trained by human beings. They also learn, as we say, 'on their own'. These two forms of learning are, to be sure, not radically different. In both the animal's learning consists in the changing of its behaviour under the influence of environment, and the only distinction between them is that in the first the environment is more controlled by man than it is in the second. Still, it is useful to separate the two forms, for it is when animals learn 'on their own' that the efficacy of their minds is said to be especially obvious.

Many British Association critics of my paper have brought forward examples of this kind of learning. The *Times* has published letters from Mr. C. H. Roberts, who described (Sept. 29) how a dog, finding no one at home to fill its water-bowl, carried the bowl to the house of a neighbour; from Mr. Gilbert Coleridge, who told (Sept. 23) how a pony learned to lift a gate off its hinges; and from Lieut.-Col. W. Bunbury, who gave an account (Sept. 21) of a Cairn terrier's feints. Moreover, both in the *Morning Post* (Sept. 6) and in the *Veterinary Record* (Oct. 1), Sir John Moore described how he fell one day in the hunting field and was hung up by the stirrup between his horse's legs, and how the horse stopped twenty or thirty yards from the fence and put its off hind-leg beside him.

Now, in all these cases we may accept the recorded facts without accepting the view, dogmatically laid down in each instance, that they can be due to nothing but animal reasoning. For my part, before accepting any such view, I should require to know much about each of the examples put forward—more facts about the reported occurrence, and about the past behaviour of the animal concerned. Nevertheless, I would say, even now, that the action of Sir John Moore's horse was not indisputably due, as he supposes, to "reason, memory, and other attributes of mind". The stopping of a horse, whose rider has become suspended between its legs, can quite well be explained in terms of reflexes; and I think a similar explanation would suffice in each of the other cases that have been brought forward.

If I seem here to be over-cautious in regard to the efficacy of animal minds, I have at least two reasons for my parsimony: first, there is abundant evidence that brainless animals can profit by experience—that even the naturally ganglionless starfish learns; secondly, my own observations of animal behaviour, both inside and outside the laboratory, have shown me how easy it is for animals to acquire an undeserved reputation for mental characteristics. In my Department in the University of Aberdeen, we have been making careful observations of animal learning under controlled, experimental conditions. In one of our experiments we observed the behaviour of cats learning to get out of a box which could be opened from the inside only by pulling a stirrup. Most of the cats did learn to pull the stirrup; and one in particular earned a great reputation for intelligence among visitors by the speed with which, after a time, it opened the box and got to the milk that was waiting outside. These casual visitors naturally supposed that the cat pulled the stirrup because it had consciously grasped the fact that its action would open the door. Such a supposition, however, must be discounted in view of the fact that, when the stirrup was moved, the cat still clawed the air in the place where it had been—and that, when placed beside milk outside the open box, the cat would often not touch it until it had needlessly run into the box and pulled the stirrup.

It seems, then, that, when we consider the main groups of animal actions which are said to be caused by animal minds, we find none which is clearly incapable of being explained in non-mental terms; and this was the view that I sought to express and to argue at York.

One word in conclusion. Some of my critics, notably Mr. Gilbert Coleridge (*Times*, Sept. 9) and Sir John Moore (*Veterinary Record*, Oct. 1), condemn the observation of animal behaviour under experimental conditions. In a scientific journal there is no need to rebut so perverse a

view; but I would make just two comments upon it. First, under experimental conditions we can observe the genesis of any particular action, and so avoid those false inferences to which observation of the action by itself might naturally lead. Secondly, under experimental conditions we can compare the behaviour of normal animals with that of spinal or decerebrate preparations, and thus test such mistaken assumptions as that mind is required in order that an animal should respond differently to different stimuli, or be modified by its environment.

Sir John Leslie, 1766–1832

By Prof. D. F. Fraser-Harris

The centenary occurs on November 3 of the death of Sir John Leslie, mathematician and physicist. Leslie was a native of the small town of Largo in Fife, where his father, a most intelligent man who had come from the neighbourhood of St. Andrews, was a cabinet-maker. Leslie's mother's name was Carstairs. When only thirteen years old, John was sent to the University of St. Andrews to study for the ministry of the Church of Scotland, but after six sessions there and one or two years at Edinburgh until 1787, he gave up the idea of the Church and devoted himself to the study of his favourite mathematics. His paper on "The Resolution of Indeterminate Problems" had the honour of being admitted to the *Transactions of the Royal Society of Edinburgh* when its author was as yet in his twenty-second year.

In 1793 appeared Leslie's translation of Buffon's "Natural History of Birds" in nine volumes which he had made for John Murray.

Unsuccessful as a candidate for a chair first at the University of St. Andrews and then at the University of Glasgow, Leslie retired to Largo, where he carried out these experiments which, when published in 1804 as "An Experimental Enquiry into the Nature and Properties of Heat", made his name famous throughout the world of science. In this now classical research, he employed his famous cube to study the relative absorptive and reflecting powers of a large number of materials. The 'differential thermometer' which he had devised some years earlier was now found exceedingly useful. This instrument has been described by an enthusiastic admirer as "one of the most beautiful and delicate that inductive genius ever devised as a help to experimental enquiry". The essay of 1804 won for Leslie the recognition of the Royal Society, the Rumford Medal of which was awarded him in 1805.

In the same year, Leslie was a candidate for the chair of mathematics in the University of Edinburgh, vacant through the translation of Playfair to that of natural philosophy. Leslie, whose testimonials included one from Sir Joseph Banks, was vastly better qualified in science than his only opponent, a minister of Edinburgh; but the clergy, professing to see in his essay 'an infidel note' because he had quoted approvingly some remark of Hume on cause and effect, opposed in the most vehement manner his election to the chair. All intellectual Scotland was in a state of ferment; the case was argued for two days before a court consisting of 180 members and by a majority of only 12 at midnight on the second day was Leslie acquitted of heresy (May 1805).

In 1809 Leslie published his "Elements of Geometry" which saw four editions. In the following year he succeeded in freezing water by artificial evaporation. A quantity of water was placed alongside some sulphuric acid in the receiver of an air-pump from which the air was rapidly removed. This diminution of pressure caused a vigorous evaporation from the water, the vapour being taken up by the acid as fast as it was produced. Leslie's evident joy at seeing the crystals of ice forming in the water has been testified to by an eye-witness. Leslie is therefore the 'father' of refrigerators and all manner of appliances for producing low temperatures. Most of the pieces of apparatus used in these researches were made by Leslie's own hands, and are now carefully preserved in the University of Edinburgh.

In spite of having made these fundamental discoveries in the science of heat, Leslie believed to the last in the objective existence of cold, and, in expressed opposition to Wells, held that dew was the result of "cold pulsations from the azure sky".

In 1819, on the death of Playfair, Leslie was elected to the more congenial chair of natural philosophy.

Clerk Maxwell has told us that Leslie was the first to give the correct explanation of the rise of liquid in a narrow tube by capillary attraction.

Leslie, who had travelled widely and read as widely, was in 1820 elected a *correspondant* of the Paris Academy of Sciences. He was the author of a large number of essays on mathematical and physical subjects, one of the most valuable of which was his "History of Mathematical and Physical Science during the Eighteenth Century" in the seventh edition of the "Encyclopædia Britannica".

Probably Leslie's most celebrated student was Thomas Carlyle, whose ticket, duly signed for the class of mathematics, may still be seen in the Carlyle House, Cheyne Row. Leslie had a high opinion of Carlyle's mathematical powers, and he helped him to his first appointment (1814) as teacher of mathematics in Annan Academy.

In 1832, on the recommendation of Brougham, Leslie was created a knight of the Guelphic Order by King William IV in the illustrious company of William Herschel, Charles Bell and David Brewster.

As a bachelor of frugal habits, Sir John had an income much in excess of his needs so that he was enabled to purchase the estate of Coates near

Largo, to which he used to retire in the long vacation.

In person Sir John Leslie was of short stature and very corpulent, with protruding upper teeth, of florid complexion and rather deaf. In spite of these defects, it was a weakness of his in middle life to imagine himself both young and handsome. In keeping with this purely personal opinion, he dyed his hair. Unfriendly observers have related that, as his knowledge of chemistry was not so intimate as that of physics, the colour turned out to be purple. Sir John at times could deal with a very substantial meal, for it is recorded that in some sort of dietetic contest, he ate two pounds of almonds and raisins at the close of dinner. Another of Sir John's failings was distrust of the medical profession, so that he succumbed to the results of a neglected chill brought on by a severe wetting and complicated by erysipelas on November 3, 1832.

A caricature of Leslie is to be found in the well-known "Kay's Portraits"; and a copy of the bust by S. Joseph has been placed in the National Portrait Gallery at Edinburgh.

Statistical Methods in Industry

THE conception of the ordinary business man, whether in England or the United States, of the function of statistics in industry is generally a vague one. To many the word means no more than lists of figures open to various interpretations, while few have realised that the essential element lies not in the figures but in the science of their analysis. Marketing, costing, advertising, adjusting output to anticipate fluctuations in prices and demand, and recently studies in industrial psychology, have become recognised fields for the statistician. But the link between the methods of statistical analysis and the problems of the engineer, that is to say, of the man who is concerned with the efficiency of methods of production and the quality of the thing produced, has up to the present been very little realised.

Yet when dealing with mass-production industry, the scientific method of investigation is essentially the statistical method. For whether the manufacturer is concerned with the diameter of a shaft, the strength of cotton thread or the resistance of electrical equipment, he cannot succeed in producing exactly the same article again and again; and any attempt to analyse this variation in order to locate and if possible remove some of its causes, must be based on statistical technique.

Dr. W. A. Shewhart, of the Bell Telephone Laboratories, who visited London in May to give three lectures at University College on the "Rôle of Statistical Theory in Industrial Standardization", is chairman of a committee on the development of statistical applications in engineering and manufacturing, sponsored jointly by the American Society of Mechanical Engineers and the American Society for Testing Materials. He has been largely responsible for the development of this work in the United States, and his presence in England provided just the opportunity that was needed to bring together men in different fields who had begun to realise the importance of this work in England. An immediate development resulted when the British Standards Institution called to a round table conference representatives from several engineering groups, societies and research institutes. At this meeting a small committee was appointed under the chairmanship of Mr. B. H. Wilsdon, of the Department of Scientific and Industrial Research, Building Research Station, to investigate the whole problem from the point of view of standardisation and specification. This Committee is preparing a report which will include a pamphlet intended to serve as an introduction to the subject for manufacturers and others faced with these problems. Similar action, it is understood, has been taken in Germany by the Deutscher Normenausschuss.

It is true, of course, that for a number of years individual firms have here and there made use of statistical theory in laying out efficient research programmes to improve the quality of production, or to establish sampling plans to reduce the cost of inspection; but there has been little contact between those interested on these lines. The practical worker has not fully realised the potentiality of the statistical tool, nor has he had any opportunity of discovering how similar problems have been dealt with in the research institutes or factories of other firms in the same field or in other industries. At the same time, the mathematical statistician has not understood the lines along which theory could be developed most helpfully.

Recently in Great Britain Dr. Egon S. Pearson, of the Department of Applied Statistics at University College, London, has taken a leading part in an attempt to bring together those different interests. Dr. Pearson has not only made important contributions to the theory involved in this new field of practical statistics, but also has had the advantage of making a close study of its application to large-scale American engineering problems; while at the York Meeting of the British Association he contributed a paper on statistical methods in the quality-control of output, which attracted a considerable amount of attention.

The Biometric Laboratory at University College, with its position in London and its long tradition as a workshop of statistical tools, would appear to be admirably placed as a centre for the development of education and research in this particular field.

Obituary

PROF. KARL, RITTER VON GOEBEL, For. Mem. R.S.

THE death occurred on October 9 of Geheimrat Prof. Karl, Ritter von Goebel, professor of botany in the University of Munich, president of the Bavarian Academy of Sciences, and foreign member of the Royal Societies of London and Edinburgh, the Linnæan Society, and leading academies of Europe and America. Von Goebel was without question the most prominent exponent of plant morphology of his time.

Two extreme aspects of biological science may be distinguished, and they are often pursued with but slight relation one to the other: namely, the morphological, which concentrates upon the form of the object studied, and the physiological, which concentrates on function. But neither of these can attain full success without the other. The best results will follow from some middle position. This is the key to the botanical work of von Goebel's life, as it was also to that of his great master, Hofmeister. Neither of these was a plant morphologist in the narrower sense of the formalist. Both tried to arrive at a knowledge of form through experimental study of the living plant. Both pursued organography, being impelled to fathom the problem: How does conformation come to be? The morphology of the present day is no longer formal and idealistic, but organographic. The change was due in the first instance to Hofmeister, Sachs, and Herbert Spencer; as von Goebel himself remarks in the preface to the first edition of his "Organographie", dated 1897. A general presentation of this newer aspect of the morphology of plants within the pages of a single book has been the work of von Goebel himself. The completion of the third and greatly extended edition of his treatise has almost coincided with its author's death.

This event may be held as closing a brilliant chapter in the history of botanical science. The period which it covers opened in 1847, when Hofmeister, by profession a bookseller and publisher in Leipzig, completed his comparative studies on mosses and ferns, and made his results public. He first brought to light the fact that a common life-history underlies the development of them all, with regularly alternating generations, one sexual the other neutral. He later extended his synthesis to include coniferous trees, thus drawing together seed-plants, ferns, and mosses into a common scheme.

Soon after the publication of these wonderful studies, Hofmeister was appointed directly from his place of business to the chair of botany in the University of Heidelberg, and afterwards went to Tübingen. Such happenings were without parallel in the rigid academic system of the time in Germany. Among the latest of the pupils of Hofmeister in Tübingen was young Goebel, who thus received at first-hand the stimulus of the greatest master of his time in plant morphology. Afterwards he became assistant to Sachs in Würzburg, and to de Bary in Strassburg: from both of these he derived experience and skill in physiological and cultural methods. Thus equipped, by education of a mind prone to quick perception and of unusual penetrating power, Goebel soon made his mark in research, and received academic promotion. His first chair was in Rostock: after a brief tenure he was posted thence to Marburg, and in 1891 he was finally appointed to the University of Munich, where he remained for life.

Von Goebel's contributions to botanical literature were extensive and varied. A complete list of them up to 1924 was included in the "Festschrift", published in 1925 in celebration of his seventieth birthday, as a double volume of *Flora*, a journal which he himself had edited since 1889. His writings range in time from 1877 to the day of his death, relating chiefly to bryophytes and vascular plants. They are based upon his own observations and collections, made during his extensive journeys to both eastern and western tropics, and particularly to Java, and the Buitenzorg garden. They deal not only with material collected in the open, but also include the results of his cultures within the Munich garden, over which he had official control. His experiments, summarised in his "Experimentelle Morphologie der Pflanzen" (Leipzig, 1908), were directed mainly towards a knowledge of causality, and particularly to the elucidation of the effect of environment upon symmetry. Such inquiries he seemed to prefer above those leading directly towards phyletic conclusions. Indeed he always appeared to feel some mistrust of phyletic argument, and to prefer to search deeper into the causality of those features which are too often used as mere counters in facile comparison by students of descent. In this preference he will always have the sympathy of those interested in phylogeny who wish for sound conclusions rather than immediate results.

In 1924 von Goebel published a volume in celebration of the centenary of the birth of his master, Hofmeister. A translation was published in 1925 by the Ray Society (vol. 111), and reviewed in NATURE for October 2, 1926. Nothing that he ever wrote is more self-revealing than this small book. The former student, himself a professor of more than forty years standing, who had travelled in all quarters of the world, and possessed an exceptional knowledge of plants whether growing in the open or as subjects of experiment, gives a truly philosophical analysis of his teacher's work in the light of a later generation. The book is not a mere appreciation, but a critical review. The author does not hesitate to expose points where Hofmeister's earlier position does not accord with later aspects of the science. As remarked by the reviewer in NATURE, this feature, associated with an unusually penetrating mind, makes von

Goebel's volume a most valuable addition to philosophical botany.

The production of von Goebel's "Organographie der Pflanzen", with its three progressive editions, has been a very great achievement. So large a book is in danger of suffering from the wealth of its material. When a work runs to more than 2,000 large pages, with above 2,000 illustrations, there is a risk of its becoming encyclopædic, and of its use being as a book of reference rather than a work to be read directly through. This may be but a confession of weakness in the user. As a summation of the living morphology of the time, critically stated, von Goebel's "Organography" stands unrivalled, whether as the achievement of a single brain, or as an epitome of the work of a long life of intense activity, and of unusual opportunity. Nothing like it has appeared before in the literature of botany.

Von Goebel has been a *persona grata* in his frequent visits to Great Britain. This was due partly to his own personality, partly to the character of his work, and partly it was a consequence of his command of the English language. His first introduction to British readers as a body was through his revision of the systematic section of Sachs's textbook, the translation of which was published by the Oxford University Press, under the title of "Outlines of Classification and Special Morphology of Plants" (1887). This was followed by the translation of the first edition of his "Organographie der Pflanzen" (1900–1905), both being edited by Sir Isaac Bayley Balfour. These books readily reached the hands of advanced British students: but for those engaged in morphological research von Goebel's more special writings have been for more than half a century indispensable: not only have they provided a wealth of new facts, but they have also been more influential than those of any other current writer in shaping the course of morphological inquiry.

Prof. von Goebel was born in 1855, at Billighem in Baden. He was tall and robust in figure, but with a face that suggested gentleness of character, combined with a dreamy expression of the eyes. He was, however, firm in his opinions, and resolute in their support. Nevertheless his manner in controversy was restrained, and tinged sometimes with humour. This came out particularly in his use of well-chosen classical quotations, applied so as to soften the otherwise keen point of an argument. He leaves behind the memory of a gracious personality, to whom the science of botany owes a supreme debt not only as a great observer, but also as a safe guide to correct channels of thought. F. O. B.

MR. A. CHASTON CHAPMAN, F.R.S.

CHEMISTRY sustained a severe loss in the death on October 17, at sixty-three years of age, of Alfred Chaston Chapman, one of the remaining chemists of a type that is disappearing. A consulting chemist and public analyst with a large and important practice, up to the last he was indefatigable in the pursuit of his scientific studies, and this in spite of the many calls on his time arising from the public duties and the many voluntary services he undertook.

Chapman received his training in chemistry at University College under Williamson, and remained in close touch with that College when Ramsay succeeded as professor. While quite young he started for himself as a consulting chemist, specialising in the fermentation industries, and soon acquired a position which was enhanced by his published work. An excellent organic chemist, he investigated the constituents of the essential oil of hops, some of them in great detail, such as humulene, and applied the same methods to the identification of a new hydrocarbon (spinacene) present in large quantity in certain fish liver oils. In the domain of general analytical work he contributed many useful processes; he was alive to the application of new chemical reagents and methods, to which he devoted a lecture to the Chemical Society, and in this connexion strongly advocated setting up chairs of analytical chemistry in the universities, on account of the range of discipline and chemical experience afforded by that subject.

Equally interested in life processes—he never ceased to marvel at the "wonderful laboratory of the yeast cell"—Chapman devoted much time to mycological and bacteriological work, evolving processes which required this technique. Some of this he described in special papers and an account of his views on the industrial uses of micro-organism will be found in his Cantor Lectures before the Royal Society of Arts. These studies led him to advocate with his usual cogency the setting up of an Institute for Industrial Microbiology, in which would be carried on systematic research and training, together with the formation of a collection of pure cultures. Although this has not materialised, his advice as a member of the Chemistry Research Board of the Department of Scientific and Industrial Research was valued in connexion with a start that is being made towards the fulfilment of some of these objects. In 1920 he was elected into the Royal Society.

Many institutions sought the advantage of Chapman's sound judgment of men and things. Thus he had held the offices of president of the Institute of Chemistry, of the Society of Public Analysts, of the Royal Microscopical Society, of the Institute of Brewing, and he was vice-president and benefactor of the Royal Institution. Of his assistance to Governmental committees, examples are his membership of the Royal Commission of Awards to Inventors, the scientific panel of the Board of Trade, Advisory Committee of the Imperial Institute, and the Forest Products and Chemistry Research Boards of the Department of Scientific and Industrial Research.

Among Chapman's activities was his interest in the antiquarian side of chemistry, and he delighted

to show to his friends and describe with detailed knowledge his library of books relating to the time when the Royal Society was founded and the succeeding century.

Chaston Chapman will be remembered as a cogent writer and exponent of his views, but his friends have to lament the loss of one whose striking and dignified figure, kindly humour and uniform graciousness endeared him to so many.

ROBERT ROBERTSON.

WE regret to announce the following deaths:

Prof. Louis Duparc, professor of mineralogy and petrography, analytical chemistry and toxicology at the University of Geneva, a foreign member of the Geological Society of London, known chiefly for his work in mineralogy, on October 21, aged sixty-six years.

Dr. Barton W. Evermann, director of the Museum and the Steinhart Aquarium of the California Academy of Sciences, who has published much work on ichthyology, especially with relation to the geographical distribution of fishes, on September 27, aged seventy-eight years.

Prof. K. K. Gedroiz, director of the Experimental Station of the Scientific Institute of Fertilisers, Moscow, a well known worker in soil science, on October 5.

News and Views

Diary of Societies

ANNOUNCEMENTS of meetings of scientific societies, and lists of papers to be read, have increased so greatly in recent years that it has become necessary to reconsider the claims which such particulars may reasonably make upon the space they have hitherto occupied in the "Diary of Societies" in NATURE. From the point of view of interest, it may be doubted whether weekly lists of meetings and papers running to three columns or more merit publication. In most cases fellows of societies receive such announcements direct, and the chief advantage of including the lists in our "Diary" is that fellows of other societies may see what is coming on, and may wish to attend meetings outside their own special societies. Several difficulties arise, however, even on this assumption. Meetings of scientific and technical societies are usually not open to visitors, and often a dozen or more papers may be announced in a list though only one or two papers may be actually read, the rest being read in title only.

Announcements and Reports

IF it is suggested that full lists of papers serve a useful purpose as indicating directions of scientific activity, then the question arises why such lists should be limited to London and some provincial centres. NATURE is an international organ of science, and might just as appropriately publish weekly lists of papers communicated to national scientific societies and academies outside Great Britain. Under "Societies and Academies", we record the proceedings of many such societies, giving short summaries of papers received, while our columns of "Research Items" direct attention to subjects of particular interest or importance. There is thus little justification for devoting excessive space to announcements of ordinary meetings and lists of papers, and we propose in future to include under the title of "Forthcoming Events" only special meetings, lectures, and discussions, or meetings at which single papers or topics having much the same character as that of lectures are being presented. In adopting this plan, we have in mind not only considerations of space but also the interests of the majority of the readers of NATURE abroad as well as at home; and we need scarcely add that any suggestions as to what might be usefully included or excluded from this new scheme, bearing these two points in mind, would be much appreciated.

The Shirley Institute

SOME anxiety regarding the future of the Shirley Institute was expressed at the annual meeting of the British Cotton Industry Research Association at Didsbury, Manchester, held on October 19. These misgivings were not about the ability of the Institute to continue to carry out fruitful investigations but about the necessary financial support. The Institute has a staff of two hundred, more than sixty of whom are university graduates, and Dr. R. H. Pickard expressed the opinion that the Institute could usefully employ at least twice as many people as at present on the investigation of scientific and technical problems to which the industry requires answers. The work on investigating current trade problems has grown to such an extent as to crowd out much of the fundamental research, and only one sixth of the work is now the long distance research upon which the future of the Association and the industry so largely depends. Financial arrangements made in connexion with the Rayon Department terminate next June and those for the Cotton Department in June 1934. With the exhaustion of the £1,000,000 fund, Government grants to the Association will in future come by annual vote and may accordingly be still further decreased through the need for public economy. The Institute costs about £65,000 a year to run and there is a deficit on the past year of £5,600, largely owing to a corresponding reduction in the Government grant. Only about £25,000 comes from the subscriptions of the 1,200 firms who are members of the Association and these subscriptions were described by the chairman, Mr. H. P. Greg, as ridiculously out of proportion to the size and importance of the cotton industry even in times of bad trade. Contributions of £10 from a firm with a capital of £100,000 or 50,000 spindles, or of £5 from a manufacturer with 1,000 looms are unworthy of the industry or of the results obtained.

Research and the Cotton Industry

The actual results obtained in the scientific research carried out at the Shirley Institute are the property of the members subscribing and this undoubtedly handicaps the Association in propaganda work. Enough regarding the work, however, was revealed in general terms at the annual meeting to indicate the actual and potential value of the Institute to the industry. The staff has been in contact during the year with more than 90 per cent of the member firms. Results already obtained fully justify Mr. Greg's assertion that economy on research even in the days of bad trade is unwise and unprofitable, and that the Association is worthy of far more generous support by the industry. The number of problems already raised by members which cannot be attacked by the Institute is considerable and the diversion of effort from long-range or fundamental research to current trade problems is a serious threat to the future development and prosperity of the industry. These are matters in which the nation as a whole is vitally concerned, but it cannot be expected that the direct contribution of the State can be materially increased except *pari passu* with a fitting acceptance by the industry itself of its own financial responsibilities for research.

Archæological Studies in Mexico

A decision of the Supreme Court of Mexico, it is reported by Science Service (Washington, D.C.), is expected during the current month, which is of considerable moment for the future study of the archæology of Central America. The point at issue is the control by individual States of the archæological sites within their respective boundaries. For some years the Central Government, largely owing to the influence of Señor Gamio, himself an archæologist of note, has displayed commendable energy in the examination and excavation of the archæological sites of the country. Any decision which would hamper or disturb the organisation of systematic exploration would be unfortunate in the extreme. The arrangements for the season now opening are already complete; but work cannot go forward until the decision of the courts is known. It may be hoped that whatever the verdict, some *modus vivendi* will be attained to satisfy both local interests and any claims the Central Government may justly put forward on the ground of its superior facilities for organised research.

The archæological activities which are delayed pending decision are considerable. At Monte Alban, where the now famous gold treasure was discovered in a tomb this year, an appropriation three times as large as that of last year is to be expended in the further excavation of the innumerable tombs on the site; while stratigraphical study is to be carried on with a view of correlation with Maya sites to the east, south and north. The exploration of a Zapotec fortress known as Quiengola, south of Monte Alban, is to be initiated; and further explorations are to be made in the tomb at Texmelincan, the remote area of Guerrero, from which part only of the contents, including a number of gold objects, was removed at the time of its discovery early this year. In the important Toltec city of Teotihuacan, near Mexico City, the excavation of the "Avenue of the Dead", the mile-long central axis of the city with its row of mounds, now known to be the platforms of temples, is to be continued. At Chichen Itzá, which may be considered the strategic point for at least one period of Mayan history, important work on the interior of the pyramid of the Temple of Kukulkan, the Bird Snake, will be carried further. This pyramid, 90 ft. high, is the highest in the city, and in last season's excavation was found to enclose a smaller pyramid. It is intended this year to explore this contained pyramid and search for other internal structures. This outline of impending excavation, brief as it is, will indicate the extent of the interests involved in the forthcoming decision, quite apart from any questions which may arise affecting the position of the numerous expeditions from the United States now operating in Mexico.

The Horniman Museum and Library

The late Mr. Emslie J. Horniman has bequeathed a sum of £10,000, free of duty, to the London County Council, for the purpose of providing an extension to the Horniman Museum, Forest Hill. The Museum was built by the late Mr. John E. Horniman, father of the testator, and before it was opened to the public he presented it and its contents, in 1901, to the London County Council. As is usual, and perhaps inevitable, in museums, the collections have since outgrown the accommodation, with the result that cases have become overcrowded, and progress has been hampered. This is more especially so with the collections dealing with the material culture of backward peoples. The provision of additional space will enable the present exhibited series to be opened out and extended, thus furthering that educational arrangement of the collections which has been the constant aim of the Museum authorities. It may be noted that Mr. Horniman's interest in the Museum has been shown in many ways, notably in the provision, in 1912, of an extension for the purposes of a lecture hall and library.

Under Dr. H. S. Harrison, who was appointed curator in 1904, the collections have been built up continuously with the view of the function of the Museum as providing material for the study of the development of the arts and crafts of primitive races and the natural history of man and animals. The educational value of the Museum collections has been much enhanced by the excellent series of handbooks, prepared by the staff, which deal, in a scientific spirit, but in not too technical a manner, with the developmental aspect of the collections, illustrating such topics as fire-making, transport, tools from the stone age to the steel age, and the like. The enlightened policy of the education authority for London in promoting lectures on the

Museum collections and related subjects, which teachers are encouraged to attend, has given the Horniman Museum a unique place among the educational facilities of London.

The Royal College of Physicians and Preventive Medicine

IN his Harveian oration delivered before the Royal College of Physicians of London on October 18, Sir George Newman, chief medical officer of the Ministry of Health, discussed the debt of preventive medicine to Harvey and the College. He showed first of all that Harvey's discovery of the circulation of the blood led directly to the conception of physiological balance elaborated by Claude Bernard, who formulated the synthetic principle that all the vital functions of the body establish jointly a constant and stable internal environment for the organism living in a variable external environment. Subsequent discoveries proved that physical health and mental capacity depend upon a mutual contribution of nutrition, hormones, nervous regulation and oxygenation of the circulating blood, and that these factors act in the prevention of disease. The application of the Harveian method and spirit to the study of the cause and control of infective disease and artificial immunity was then considered. Sir George maintained that throughout its history the Royal College of Physicians, with which Harvey was so closely connected, has been the foster-mother of sound medical practice and has cultivated the Renaissance spirit of true learning and inquiry. The preventive work of the College is illustrated by its participation in the pharmacopoeias published between 1618 and 1851, after which year this duty was transferred to the General Medical Council by the Medical Act of 1858; its recommendations drawn up in 1720 for the prevention of plague; its petition to Parliament in 1725 which led to the suppression of gin shops and the restriction of private retail sales; its constant advocacy of vaccination; the introduction of registration of the causes of death and the nomenclature of disease in 1837; and the creation in conjunction with the Royal College of Surgeons of a diploma of public health and afterwards of a similar diploma in tropical medicine and hygiene. In conclusion, Sir George dealt with the development of a communal medical service and emphasised the necessity of mutual co-ordination between all channels and means of medical activity.

Chaucer and Contemporary Medicine

AT a meeting of the Osler Club on October 21, Dr. J. D. Rolleston read a paper on "Chaucer and Medieval Medicine", which he commenced by a quotation from the modern version of some of the "Canterbury Tales" published in 1700 by Dryden, who after describing Chaucer as the father of English poetry continues: "He is a perpetual fountain of good sense, learned in all sciences and therefore speaks properly on all subjects. . . . Chaucer followed Nature everywhere, but was never so bold as to go beyond her." Although a few references to Chaucer are to be found in the works of some British medical historians, no essay dealing with the allusions to contemporary medicine in his works has hitherto been published, if one may judge from the absence of any entry in the Surgeon-General's Catalogue relating to Chaucer, in striking contrast with medical articles on Shakespeare or Goethe or even Dante and Byron. Dr. Rolleston, however, maintained that not only in the "Canterbury Tales", including the lengthy prose discourses of Melibeus and the Parson, as well as in Troilus and Criseyde, but also in many of the minor poems, there is much to interest the medical reader as well as delight the literary student. After a brief sketch of Chaucer's life, during which the poet became acquainted with all ranks of society, including men of science and learning, Dr. Rolleston dealt with the passages of medical interest in his works under the four headings, the medical profession in Chaucer's time, prevalent medical doctrines, diseases and their treatment, and miscellaneous topics.

Monument to Ernest Solvay

ON October 16 in the presence of the King of the Belgians and the Duke of Brabant, a monument was unveiled in Brussels to Ernest Solvay, the eminent chemist, philanthropist and publicist. Solvay was born at Rebecq in Brabant on April 16, 1838, and died in Brussels on May 26, 1922. The foundation of all his success in chemical industry and his immense wealth was his discovery of the ammonia-soda process. To the unfortunate Nicholas Leblanc (1753–1806), whose statue stands in front of the Conservatoire des Arts et Métiers in Paris, the world owed the first successful process for manufacturing artificial soda, and by 1863, the year in which Solvay took out his patent, the world production of soda was about 300,000 tons a year. The Solvay process, after the many initial difficulties had been overcome, proved far more economical than the Leblanc process, and by 1914 there were some twenty-three works in various parts of the world engaged in the Solvay ammonia-soda process, capable of producing about 2,000,000 tons of soda ash a year. Mr. Runciman, President of the Board of Trade, in a speech delivered on October 20, when dealing with the question of trade recovery, said that "one first-class invention is worth fifty Acts of Parliament". To that class of invention Solvay's belongs.

Trevithick Centenary

THE centenary of the death of Richard Trevithick occurs next April and steps have been taken by the Newcomen Society to commemorate Trevithick's life and work. In response to an invitation sent out by the Society, there was a large gathering of representatives of engineering institutions from many parts of Great Britain at a meeting to discuss the matter held at the Institution of Civil Engineers on October 20, and a committee was formed to deal with the commemoration as an international affair. The president-elect of the Institution of Civil Engineers is to be asked to be chairman of the committee and Mr. H. W. Dickinson, honorary secretary of the

Newcomen Society was elected secretary. The committee has been asked to consider the questions of memorial services in Westminster Abbey, where there is a window to Trevithick, and at Dartford Church, in the grounds of which he was buried; a memorial lecture; the placing of tablets at Euston, where his engine "Catch-me-who-can" ran, on the site of his birthplace and at Penydarran, South Wales. It is also proposed to publish a memorial volume containing a good account of his life and work; no such work is at present available.

The Electric Grid

Prof. E. W. Marchant gave his presidential address to the Institution of Electrical Engineers on October 20. After discussing training and research he dwelt on the importance of some of the applications of psychology which enable men most suitable for special kinds of work to be chosen. For example, in direction-finding work in the Navy, it has been found possible to pick out men who can tell with high accuracy the direction from which a sound comes. Prof. Marchant went on to speak of the electric grid in Great Britain which has been in course of construction for the last four or five years and will be completed in a few months. The original eight year programme has been cut down by two years. The next stage in the development of electricity is the trading stage. Assuming that progress proceeds as rapidly as during the development of the grid, Great Britain will soon be completely electrified. Prof. Marchant divided the supply of electricity into three stages, generation, transmission and distribution. So far as generation is concerned, the range of possible improvements is now small. Similarly, great improvements have been made in the technical design of transmission lines. It is the final stage of the problem, namely, the distribution and utilisation of electrical energy, which offers the greatest scope. To do this successfully, there must be a great demand and the public must be educated so as to be ready to take full advantage of electricity for all kinds of purposes. He mentioned that in Germany electrical laboratories have been installed at small cost by manufacturers in all schools. These are equipped with electrical apparatus so as to familiarise the children with electrical heaters, cookers, kettles, irons, etc.

Meteorological Effects during the Total Solar Eclipse

Dr. C. F. Brooks, of the U.S. Weather Bureau, has given a brief preliminary account (*Bull. Am. Meteorological Soc.*, Aug.–Sept. 1932, vol. 13, pp. 159–160) of the co-operative effort made in the United States and eastern Canada to determine the effects upon the atmosphere of the total eclipse of the sun on August 31 last. The programme of meteorological observations was determined largely by the Blue Hill Observatory of Harvard University, but the scheme was carried out with the aid of many public bodies and private individuals. Special measurements were made of the radiation from sun and sky; conditions in the upper atmosphere were measured by meteorographs carried by aeroplanes and captive balloons; numerous ordinary meteorological observations were carried out by the regular observers of the U.S. Weather Bureau and by a large number of auxiliary voluntary observers.

The large mass of observational material obtained in this way has still to be examined and discussed; Dr. Brooks mentions, however, a few interesting facts that have already come to light. He suggests that the cloudy skies that spoiled the view of the eclipse for so many and interfered with the work of the astronomers, were far from being a drawback for the meteorological work. There were clouds at five different levels in parts of New England, and these included both stratiform and cumuliform clouds. Generally speaking, the cumulus clouds, which half covered the sky locally just before the eclipse, disappeared during the eclipse, as the cutting off of the main heat supply for the surface layers of the atmosphere checked convection, but the stratiform clouds higher up in some instances developed rapidly, so as to cause the sky to become completely overcast. Upward-flowing mountain breezes generally ceased, but, doubtless owing to the short duration of the period of reduced radiation, katabatic winds did not develop. The fall of temperature near the ground varied greatly, mainly owing to the changing amount of cloud: it ranged from 2° F. to 11° F., the latter figure representing the combination of two favourable factors—absence of cloud and sandiness of the soil, with its concomitant low specific heat. The publication of the more complete discussion of the observations will be awaited with interest by meteorologists.

Elm Disease and its Distribution

For the fifth year in succession the Forestry Commissioners have had a survey made on the status of the elm disease (*Graphium ulmi*). First observed on the Continent in 1919, and in England in 1927, the disease is now common throughout western and northern Europe, and more recently its occurrence has been noted on a few trees so far away as Ohio in the United States. In England between 1927 and 1931 it increased steadily both as regards the number of outbreaks and the damaging effect on the trees. The most notable feature in this year's survey is the reduced virulence of attack in nearly every area visited. It is quite impossible to say whether this diminution is merely a temporary check in the progress of the disease or the first sign of recovery. Elm bark beetles have long been suspected as being the principal means by which the disease is spread and this has now been proved to be the case. A great deal of work has been carried out in Holland on the relative resistance to attack of the various species of elms. So far only certain Asiatic species have proved immune and for the most part these are small trees unlikely to take the place of the English elm. All kinds of elms ordinarily planted in England appear to be susceptible; but, judging from the investigations conducted in Holland, there is some foundation for the hope that completely resistant forms of the common species may yet become available.

Recent Acquisitions at the Natural History Museum

THE Entomological Department of the British Museum (Natural History) has recently acquired the collection of the economically important Thysanoptera, or thrips, formed by Dr. R. S. Bagnall, comprising more than 17,000 specimens, of which about 430 are types and 750 paratypes. Some 8000 insects of various orders, but mainly Diptera, have been collected for the Department in the High Tatra Mountains in Poland and Czechoslovakia by Miss D. Aubertin and Miss E. Trewavas. The King of the Hedjaz, Nejd, and its Dependencies has presented to the Geological Department the collection of fossils made by Mr. H. St. J. Philby on his recent remarkable journey in Central Arabia. It includes invertebrates from the Jurassic rocks of the Tuwaiq plateau and the Cretaceous rocks of the Arma plateau, near Riyadh, the Wahabi capital. From the area south of the Gulf of Bahrein, invertebrates of Miocene age, closely resembling those of contemporaneous rocks in the Persian oilfields, were obtained; while freshwater shells found in abundance at several localities in the middle of the great Rub' al Khali Desert show that rivers or lakes existed recently in that now arid region. The Government Geologist of the Anglo-Egyptian Sudan has presented a series of shells of Lower Tertiary age preserved in a remarkable kind of flint; these are the first fossils, other than a few plant remains, to be found in that territory. A large selection of material from the meteorite craters discovered in 1931 near Henbury, Central Australia, has been acquired for the Department of Minerals from the Kyancutta Museum, South Australia. This includes 172 pieces of meteoric iron with a total weight of 604 lb. The largest piece of 292 lb. was found in contact with three other masses (total weight 440 lb.) at a depth of 7 feet in the smallest of the thirteen craters. This is the only meteorite that has ever been excavated from inside a meteorite crater.

Additions to the Botanical Collections

MISS E. HOMBERSLEY has given to the Department of Botany of the Natural History Museum 882 paintings of British flowering plants by Miss Ellen Hawkins, who died in 1864. The paintings are of considerable merit and are accompanied by descriptions, written on the opposite page of the double sheet, which give interesting details and information. Miss Hawkins wrote the botanical appendix to Robertson's "Handbook to the Peak" (1854). Mr. Reginald Cory has presented the original manuscript and drawings of the "Tabular Distribution of the Vegetable Kingdom" by John Stuart, third Earl of Bute. The Department already possesses many plants purchased at the Earl of Bute's sale in 1794. Prof. John Percival has presented a set of all the known species of *Ægilops*. Prof. Percival's knowledge of this difficult genus of grasses makes the set of special value. Among the purchases there is a further set of H. J. Schlieben's Tanganyika plants and 668 Brazilian and Mexican plants collected by Y. Mexia and 248 drawings of liverworts (Jubuleæ) by Fr. Verdoorn.

Epidemic Diseases in Residential Schools

THERE has been since August a slight rise (which was anticipated) in the incidence of an epidemic disease of the nervous system named poliomyelitis (an infection which may sometimes result in 'infant paralysis'), though up to the present the cases have as a whole appeared singly and widely scattered. The Ministry of Health has, however, received certain inquiries as to the wisdom or expediency of closing residential schools in which such isolated cases may have occurred. The Ministry of Health is definitely of the opinion that the balance of advantage is in favour of not closing a residential school in which poliomyelitis has appeared. If the school be closed, any potential infectiousness of the disease is more widely distributed, and passes beyond such means of supervision and control as are furnished in a well-equipped residential school conducted on hygienic lines.

Co-operation of Scientific Societies

MANCHESTER chemical societies have initiated a form of co-operation which should prove of considerable value both to their members and to local industry generally. The Manchester and district sections of the Institute of Chemistry, the Society of Chemical Industry, the Society of Dyers and Colourists, the Oil and Colour Chemists' Association and the Institute of Rubber Industry, together with the Manchester Literary and Philosophical Society, have established a Joint Advisory Committee, consisting of the honorary secretaries (or other representative) of the societies concerned, in order that problems of mutual interest can be discussed and common plans arranged, and to provide a means whereby Manchester chemical opinion can be ascertained and expressed. The Committee has already published a card calendar of meetings, both scientific and social, of the participating societies, and a booklet which gives lists of officers as well as syllabuses and other information concerning the session's activities. The Chemical Society, not being organised in local sections, does not participate directly in the scheme, but—as is indicated in the booklet—fellows of that society may, under a co-operative arrangement, read papers on pure chemistry before the local section of the Society of Chemical Industry. Members of one society are cordially invited to attend meetings of any other society; hence by the promotion of personal contact and by the provision of facilities for discussion and joint action, Manchester chemists are effecting a consolidation of their own interests as well as providing an interesting experiment which will probably be found worthy of wider application. The Association of Secretaries of Technical Societies in Glasgow has also issued a programme of the meetings of the chemical and engineering societies in that city.

Musk Rat Menace

THE Trustees of the British Museum had under consideration at their meeting at the Natural History Museum on October 22 the serious position in the

country in relation to the musk rat menace, and particularly to the fact that now that the keeping of musk rats is prohibited except under the strictest regulations against their escape, the musk rat farmers have turned their attention to the coypu or nutria, an aquatic South American rodent. The latter animal is as large as a beaver, but has a tapering tail; it lives in burrows, and its fur is brown, soft and dense. The Trustees decided to recommend to the authorities concerned that the nutria should, like the musk rat, be scheduled as an animal the import of which is prohibited and which shall be kept only under licence.

Bartholomew Diaz off Cape Colony

MR. S. A. MUMFORD, of Tresta, Farley, Salisbury, Wilts., has written stating that the voyage of Bartholomew Diaz, when he touched the south coast of Cape Colony, is usually quoted as having taken place between August 1486 and December 1487, whereas in our "Calendar of Geographical Discovery" (NATURE, vol. 129, p. 177, Jan. 30, 1932), a note on the voyage appears under the date Feb. 3, 1488. The date given in our columns is based on a marginal note, probably by Christopher Columbus himself, on folio 13 of a copy of Pierre D'Ailly's "Imago Mundi", which fixes Diaz's return to Lisbon in the month of December 1488. The writer says he was present at Diaz's interview with the King of Portugal when the explorer's chart was shown and discussed. The "Imago Mundi" is at present in the Colombina at Seville.

Announcements

THE De Morgan medal of the London Mathematical Society, which is awarded triennially, has this year been awarded to Bertrand Russell in recognition of his mathematical work. The medal will be presented at the annual general meeting of the Society which will be held at Burlington House, Piccadilly, London, W.1, on November 10, at 5 P.M.

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 24, the following Council was elected: *President:* Sir E. A. Sharpey-Schafer; *Vice-Presidents:* Prof. J. H. Ashworth; Dr. A. Logan Turner; Dr. J. B. Clark; Prof. James Ritchie; Sir Thomas Holland; The Hon. Lord Sands; *General Secretary:* Prof. R. A. Sampson; *Secretaries to Ordinary Meetings:* Prof. C. G. Darwin and Prof. F. A. E. Crew; *Treasurer:* Dr. James Watt; *Curator of Library and Museum:* Prof. D'Arcy W. Thompson; *Councillors:* Dr. Murray Macgregor; Dr. A. Crichton Mitchell; Prof. P. T. Herring; Prof. James P. Kendall; Prof. T. M. MacRobert; Prof. Godfrey H. Thomson; Dr. Malcolm Wilson; Prof. E. B. Bailey; Prof. J. C. Brash; Prof. A. J. Clark; Prof. A. G. Ogilvie; Prof. E. M. Wedderburn.

PROF. E. N. DA. C. ANDRADE will give four lectures at the Royal Institution on Tuesdays at 5.15 P.M. beginning November 1 on "Rays and Radiations". The course is an experiment in the treatment of a branch of modern physical science on the lines of the popular Christmas Lectures to juveniles, but Prof. Andrade will address himself on this occasion to the grown-ups. He will talk and show experiments on the gamma and ultra-violet radiations, X-rays, infra-red rays, and the particle radiations which have been used in the investigation of the inner structure of the atom. Prof. Lancelot Hogben will give three lectures, also on Tuesdays at 5.15 P.M., beginning November 29, on "Colour Change in Animals". The mechanism of colour change in such a well-known example as the chameleon will be discussed, and compared with that in other animals subject to colour changes, such as the frog, the salamander and certain fishes.

THE Council of the Institution of Civil Engineers has awarded the Indian Premium for the session 1931–32 to Sir Bernard D'O. Darley (Bahawalpur, Punjab), and the Webb Prize for the session to Mr. B. G. White (London) for papers read and discussed at ordinary meetings of the Institution. The following awards for the session have been made for "Selected Engineering Papers", published without discussion:—A Telford Gold Medal to Dr. J. F. Baker (Abbots Langley); Telford Premiums to Mr. William Muirhead (London), Mr. E. B. Cocks (London), Dr. James Orr (Glasgow), Dr. W. J. Walker (Johannesburg), and Mr. W. C. Ash (Vizagapatam, India); and a Crampton Prize to Mr. L. St. C. Rundlett (Rangoon, Burma). Awards have also been made for papers read at students' meetings in London, or by students before meetings of local associations, as follows:—The James Forrest Medal and a Miller Prize to Mr. D. J. Anderson (Glasgow), and Miller Prizes to Messrs. A. C. L. Browne (London), C. W. Scott (London), A. J. P. Pashler (Birmingham), W. D. McFadyean (London), Granville Berry (London), P. J. Stuckey (Cardiff), W. H. Morgan (Newcastle), R. R. W. Grigson (London), E. A. Turner (London), and Frank Breakwell (London).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A University lecturer and a University demonstrator in biochemistry at the University of Cambridge—The Professor, School of Biochemistry, Cambridge (Nov. 9). A junior assistant and guide-lecturer at the City of Birmingham Museum and Art Gallery—The Keeper (Nov. 11). An Armourers and Brasiers research fellow in metallurgy of the Royal Society—The Assistant Secretary, The Royal Society, Burlington House, W.1 (Nov. 14). A lecturer and tutor in hygiene in the Department of Education at the University of Bristol—The Secretary and Registrar (Nov. 19).

ERRATUM.—Letter on "Possible Existence of Multiply Charged Particles of Mass One" by Dr. M. Delbrück in NATURE for October 22: p. 627, col. 1, line 33, for "an α-particle is stable . . ." read "a particle in the α-particle is stable. . . ."

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Bast-Sap in Plants

IN 1858 Th. Hartig directed attention to the fact that many trees yield drops of sap when their bark is punctured in summer and autumn. This sap issuing from the inner layers of the bast was said to include small quantities of nitrogenous substances with large quantities of various kinds of sugar. Obviously its motion and constitution might yield some information on the transport problem of organic substances. We found the most abundant flow when the puncture reaches the inner layers of the bast; deepening the puncture so as to reach the wood, causes the sap exuded to be instantly drawn in by the tensile water in the vessels. Hence the exuded sap is not driven out by root-pressure through the outer xylem. The exuding sap is transmitted by the sieve-tubes as we demonstrated by forcing a solution of potassium ferrocyanide into the puncture and afterwards tracing its path by means of ferric chloride.

In a stem of a young specimen of *Fraxinus excelsior* about 12 cm. in diameter all the seven or eight layers of soft bast transmitted the solution to some extent, while the inner layers transmitted it most readily. A pressure of 3 atm. drove the solution 3·5 cm. in 30 min. We have observed the flow of bast-sap in forty to fifty species of trees and in several herbaceous forms during June, July, August and September. All specimens of the same species in the same locality do not exude bast-sap simultaneously. The amounts exuded are variable. In active specimens the flow from a slit 1 mm. long continues for 30–45 min. and yields 0·1–0·2 c.c. Active flow from one puncture inhibits or reduces the flow from closely neighbouring punctures, and the amounts delivered from similar punctures at the same level, even when not influenced by neighbouring punctures, are not uniform.

Small quantities of proteins and glucose associated with considerable amounts of sucrose were found in the sap; the presence of tannin, an oxidase and a chromogen is also indicated. The sap is extruded by the turgor of a closed system in the bast (probably the sieve-tubes), and the flow only ceases when that pressure becomes negligible. Freezing point determinations give a measure of this pressure. Unexpectedly high pressures were observed ranging from 13 to 35 atm. The forces moving the sap through the bast and forcing it through the punctures are very high. Very different pressures have been observed in the same specimen on different occasions; but so far, it has always been found that the osmotic pressure of sap issuing from a higher level is greater than that coming from a lower one. Osmotic pressure gradients of 2·2–8·9 atm. per metre have been observed in the bast of *Fraxinus excelsior*.

Lateral motion is inconsiderable compared to longitudinal movement, hence from the amount exuded through a puncture of known size under the pressures available we obtain some idea of the ease with which the sap moves longitudinally in the bast. The gradient of pressure is presumably maintained by the production of carbohydrates in the leaves and their removal by condensation into products of growth (activity of the cambium) and materials of storage (sucrose, starch, etc., deposited in the bast-parenchyma, starch-sheath, cortex and medullary rays).

The difference in osmotic pressure above and below in the intact plant is available for forcing the solvent, water, of the less concentrated solutions below into the wood, thus creating a mass-movement of the solution downwards through the bast. These and other observations seem to us to support Münch's theory of mass-movement of organic substances in the bast, and probably bring into line the results of Mason's and Maskell's investigations.

HENRY H. DIXON.
M. W. GIBBON.

School of Botany,
Trinity College,
Oct. 1.

Stability of the Liquid Carbon Dioxide in the Ocean

IN NATURE of July 2, p. 26, Dr. Wattenborg of Berlin presented some objections to my paper "On the Field of Stability of Liquid Carbon Dioxide in the Biosphere".[1]

It is a pity that Dr. Wattenberg in formulating his criticism used, apparently, only the short notice of my paper which recently appeared in NATURE[2] and not the paper itself. Had he read my original paper he would have saved himself from misunderstanding of my point of view.

The water of the ocean, like the water of all the deep continental water-basins, is heterogeneous as to its baric properties, presenting a substance which cannot be reproduced by experiment since it has the proportios of a specifically planetary phenomenon. In the ocean the water itself is subjected to pressures which can exceed 1000 atm./cm.[2] and at the same time the dissolved gases in the same water (which are in *an innate connexion with the troposphere*) are subjected to pressures which can not exceed 1–2 atm./cm.[2] In the thermodynamical conditions of the ocean's water all the carbon dioxide masses which are isolated (completely or partly) from the troposphere (that is, from the gases dissolved in the oceanic water), must exist in a special state of phases:

$$\text{liquid } CO_2 \rightleftarrows \text{gaseous } CO_2,$$

because the temperatures and the pressure of sea-water remain mostly below the critical point and above the critical pressure of carbon dioxide.

Marine organisms must have accommodated themselves throughout geological time to the specific state of carbon dioxide in the ocean. They have to obtain a special organisation in this respect.

I have indicated in my paper the following three examples among many of such accommodations:

1. The accommodation of plankton organisms in connexion with the low confines of their habitation.
2. The oxygen glands of deep-sea fishes in connexion with their respiration.
3. The conditions of life of micro-organisms in the bottom sediments of the ocean. The chemical processes in such sediments are regulated by micro-organisms. They are subject to changes under the influence of liquid carbonic dioxide, the possibility of existence of which in living environments cannot be denied.

The same peculiarities of carbon dioxide must influence many inorganic processes such as exhalations of gaseous carbonic dioxide in the gaseous and mineral springs on the sea-bottom.

The peculiar character of carbon dioxide in the ocean in comparison with its behaviour on the earth's surface must be taken into consideration in all conclusions concerning the state of the gaseous solutions in the ocean. There certainly must exist a lower limit than the gaseous solution of carbon dioxide in sea-water and therefore we must expect to find at greater depths only ions or hydrates of carbonic acids.

For further discussion on this subject reference must be made to my paper already cited. I have also discussed the subject in my lecture "Oceanography and Geochemistry" delivered in the Mineralogical Institute at Göttingen, which is to be published in the *Tschermaks Mineralog. u. Petrografphische Mitteilungen*.

Further study in the same field of research has been made by Prof. V. Chlopin, who has published his results in the *Comptes Rendus* of the Academy of Sciences, Leningrad, mentioned before. Prof. V. G. Chlopin has shown that in the same conditions, which have been demonstrated by me for carbon dioxide in sea-water, the inert gases (argon, krypton, xenon) must give hydrates, which are soluble in sea-water. Apparently the geochemistry of the inert gases offers here a new and promising ground for research.

W. VERNADSKY.

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[1] *C.R. Acad. Sci. Leningrad*, 289-295; 1931.
[2] NATURE, 129, 607, April 23, 1932.

Bead-Corona on Radio Antenna

DURING the period February-March 1932, of exceptionally dry atmospheric conditions, a curious high frequency - high tension - phenomenon was observed on several days on the antenna of the Hilversum (Holland) broadcasting station (λ = about 300 m., aerial power 15-20 kw.).

The aerial consists of five horizontal wires, strung between two metal masts sixty metres in height, and is connected at both sides to insulators fastened to two spreaders. There are five downleads, connected to the central part of the aerial wires.

On February 14, at 20.00, a corona was observed on the antenna, and this corona caused an acoustical effect such that the modulation of the emission could clearly be heard up to a distance of approximately 800 m. A reduction of the antenna power from 20 kw. to 12 kw. caused the phenomenon to disappear.

Again, on March 7, at 17.00, when the antenna power was raised from 7 kw. to 20 kw., the corona on the antenna reappeared. It consisted of slowly moving luminous spheres of about 10 cm. diameter. They first appeared at one end of an outer wire, they slowly moved, following the wires towards the downleads and disappeared at a distance of about 15 m. from their origin. Several of these luminous spheres were observed to occur simultaneously with a mutual distance of 0·5 m., so that the phenomenon made the impression of a string of beads, moving towards the centre with a speed of the order of 1 m./sec.

The phenomenon usually started at an outer wire, and when this was covered with beads over a length of about 15 m., also the second, the third and the fourth wire gradually developed the beads in a similar way. The colour of the beads varied from yellow to a light blue and pink. The sound emitted by this corona (corresponding to the modulation of the transmitter) was very distinct and could be heard up to a distance of 1–1·5 kilometres, so that a big crowd gathered round the gate of the station, listening in astonishment to the voice of a preacher, directly from the heavens.

The modulation was also plainly visible in the glittering of the emitted light. On that day again the phenomenon disappeared with the reduction of the antenna power from 20 kw. to about 10 kw. At 19.00 an increase of the aerial power caused the corona to reappear.

The same phenomenon was again observed on March 9, 10, 11, 12, and 13. Since March 16 the corona has not occurred.

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Influence of Impurities on the Transformation Point of Liquid Allotropic Modifications

RECENT investigations dealing with the properties of liquid nitrobenzene, in the neighbourhood of the melting point, are yielding discordant results. Wolfke and Mazur,[1] in a carefully purified specimen, observe discontinuities at 9·5° C.; this temperature, they suggest, represents the transformation point of two distinct modifications of liquid nitrobenzene. Stewart,[2] using X-rays, confirms the assumption. Massy, Warren, and Wolfenden,[3] Newton Friend,[4] and Piekara [5] were unable to discover any discontinuities. The interesting question arises as to how far these discrepancies may be accounted for by assuming slight impurities to have been present in the samples used.

When two diluted solution phases co-exist, we have the well-known equation

$$\frac{L}{\vartheta}d\vartheta = \frac{x_2 - x_1}{x_1}R\vartheta dx_1$$

where L stands for the heat of transformation from phase (1) to phase (2), R is the gas constant (both per gm. mol.), x_1 and x_2 are the molecular concentrations in phases (1) and (2), and ϑ denotes the absolute temperature of transformation (see, for example, Van der Waals' "Lehrbuch der Thermodynamik", vol. 2, p. 80); the pressure is here assumed to remain constant. For the difference $\Delta\vartheta$ of the transformation points of the pure substance and that of the solution, we accordingly obtain

$$\Delta\vartheta = \frac{d\vartheta}{dx_1}x_1 = \frac{R\vartheta^2}{L}(x_2 - x_1).$$

That the allotropic modifications have unequal dissolving power is a common occurrence; the dielectric constant, which influences the dissolving power, increases nearly fourfold when we pass from nitrobenzene II to nitrobenzene I; thus x_1 and x_2 may be assumed unequal. Since the heat of transformation L for nitrobenzene ((1) $\longrightarrow$ (2)) is exceptionally small (0·14 cal. per gm.), the effect of slight impurities may be to depress the transformation point below the freezing point; the liquid phase, nitrobenzene II, permanent below 9·5° C., would then disappear.

If μ denotes the integral molecular concentration of the solution and α the ratio x_2/x_1, then the term $x_2 - x_1$ varies, during the transformation (1) $\longrightarrow$ (2), from the value $\mu(\alpha - 1)$ to $\mu\left(1 - \frac{1}{\alpha}\right)$. The phase (2) appears at the temperature

$$\vartheta + \frac{R\vartheta^2}{L}\mu(\alpha - 1);$$

the phase (1), however, does not disappear entirely until the temperature

$$\vartheta + \frac{R\vartheta^2}{L}\mu\left(1 - \frac{1}{\alpha}\right)$$

is reached. In the case of nitrobenzene we may probably admit that $\alpha < 1$.

In Fig. 1 are shown the probable coexistence lines

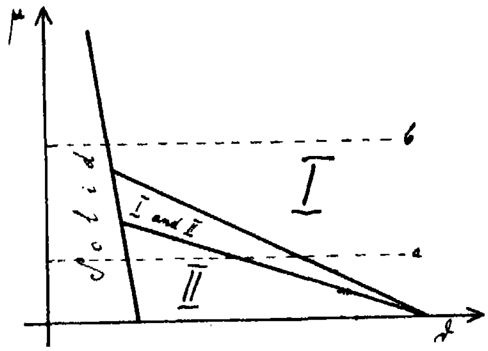

FIG. 1.

of the various phases of nitrobenzene. The dotted line a corresponds to Mazur's numerical data, the line b expresses results which would be found with samples of a less degree of purity.

STANISŁAW DOBIŃSKI.

Physical Laboratory, Jagellonian University,
Cracow, Poland, Aug. 10.

[1] Mazur, NATURE, 126, 993; 1930: Wolfke and Mazur, NATURE 127, 741; 1931: Mazur, NATURE, 127, 893; 1931.
[2] G. W. Stewart, *Phys. Rev.*, 39, 176; 1932.
[3] Massy, Warren, Wolfenden. *J.C.S.*, 91; 1932.
[4] J. Newton Friend, NATURE, 129, 471; 1932.
[5] A. Piekara, NATURE, 130, 93; 1932.

Proof of Stability of Poiseuille's Flow

IN some recent papers[1] it is shown that there exists an absolute analogy concerning the question of stability of

(1*a*) disturbances being symmetric about the axis, of P.'s flow (= steady flow through a straight pipe of uniform circular section).	(1*b*) two dimensional disturbances of the steady flow between two parallel planes, the velocity being a linear function of the distance y from the axis.
(2*a*) three dimensional disturbances of P.'s flow.	(2*b*) two dimensional disturbances of the steady flow between two parallel planes, the velocity being a parabolic function of the distance y from the axis.

It was, therefore, concluded that the investigation of (2*b*) would elucidate also the question of stability of (2*a*). To make the investigation of (2*b*) possible, the problem was divided into four parts according to the following scheme:

(1) α small αR large	(2) α large αR large
(3) α small αR small	(4) α large αR small

$\alpha = 2\pi/\lambda$ being determined by the wave-length, λ, of the disturbance (R = Reynolds's number). Since in the limit of vanishing viscosity (that is, $\alpha R \to \infty$) there exists the solution $\alpha = c = \theta$, $\psi = 1 - y^2$, which can be regarded as representing a degenerate oscillation of the undisturbed flow, the most important case will be α small, αR large.

It was possible to integrate the problem approximately by dividing the stream function ψ into an even and an odd part, by reducing the differential equation of the fourth order to a differential equation of the second order and by complex (Laplace) integration of the latter equation, expanding asymptotically the particular solutions, parameter and argument both being large. The even part gives the following transcendental equation for c = β/α : $e^{(1+i)z} = i$, z being $\left[\sqrt{c} - (1-c)\, ln \frac{1+\sqrt{c}}{\sqrt{1-c}}\right]\sqrt{\frac{\alpha R}{2}}$, that is, when c is small, $z = \frac{1}{3} c^{3/2} (2\alpha R)^{1/2}$.

The roots are in this limit

$$c = \left[\frac{3\pi}{2}\left(2n + \frac{1}{2}\right)\right]^{2/3} \Big/ (\alpha R)^{1/3} \cdot \frac{\sqrt{3} + i}{2}.$$

Since something similar is true for the odd part and also for α large, αR large, the absolute stability of Poiseuille's flow is established.

The detailed proofs and a discussion of the streamlines of the disturbed motion will be given in a paper to appear in the *Ann. d. Phys.*

TH. SEXL.

Institute for
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[1] *Ann d. Phys.* (4) 83, 835; 84, 807, 1927; 87, 570; 1928.

Science Teaching in Schools

IN his letter to NATURE of October 1 Mr. Shearcroft accepts the gloomy picture of the state of science teaching in schools with which we are becoming familiar. He writes as a teacher of science, but there are many other teachers of science who will not agree with him. Writing with the authority of the Committee of the Science Masters' Association I wish to put on record our opinion, shared we are certain by most of our members, that the science teaching in the schools of to-day is making an important and valuable contribution to the educational development of our young people and is helping them towards an understanding of their future surroundings which they would not obtain without it. We make no extravagant claims, but we do claim that we are giving those who leave the schools some insight into the method of separating the important from the unimportant, the true from the false, and we ask for a more just appreciation of the contribution of the science teacher to the intellectual make-up of the pupils in the schools.

The Science Masters' Association exists for the advancement of science teaching in schools and

endeavours to deal with the situation as it exists. Is it not futile to talk of the "curse of useless external examinations" so long as employers ask for a definite proof that a pupil leaving school and seeking a post has shown some capability of achievement? The example of an apparent encouragement of a narrow specialisation in physics quoted by Mr. Shearcroft unfortunately exists, and the Association is emphatically opposed to the possibility of a pass in physics on an examination of this restricted nature. But it is fair to point out that of the eight examining bodies, three only accept this inadequate section of 'Sound, Light and Heat', and two of these offer alternatives which give scope for a wider treatment of the subject. Moreover, it does not necessarily follow that because pupils may be examined in 'Sound, Light and Heat' therefore schools are unable to include a fuller treatment of physics in their curriculum; nor need a teacher feel his work is under a curse because only a part of it is examined.

The widening of examination syllabuses is continually taking place and much is being done to bring together the school teacher and the university teacher for the discussion of the problems arising out of these syllabuses. Each examining body has a method by which teachers are able to make their views known, and the tendency is all in the direction of fitting the examinations to the work of the schools and so of preserving to the teachers a free hand in the development of their subjects. The professional associations, the interests of which are not confined to economics, are closely identified with these consultations, and the Science Masters' Association is very frequently consulted on both general and more detailed questions relating to science. The Board of Education's Secondary Schools Examination Council, containing representatives of the universities, teachers and education authorities, reviews all the examinations periodically.

The Science Masters' Association is anxious for progress—witness the enthusiastic reception given to the address of our president, Dr. C. Norwood, at the annual meeting in January last—and will welcome any practical projects for the furtherance of its objects. Both teachers and examining bodies may be assumed to be actively interested in the welfare of the pupils in the schools, and, whilst purely destructive criticism of their work is easy, it is not usually very helpful.

T. HARTLEY,
(Chairman, Science Masters' Association).

Pelagic Animals off the South-West Coasts of the British Isles

THE occurrence of the skeleton of the floating siphonophore *Velella spirans* on our south-western shores is of common occurrence. But it is only occasionally that the living animal is driven ashore in large numbers. Although this is probably largely a wind effect it is of interest to put these invasions on record for future reference, for its presence may be an indication either of wind drift of surface water or of increased inflow of Atlantic water; in either of these circumstances it is desirable to know what other plankton animals showed unusual abundance.

Of previous records we have in the Plymouth Marine Fauna, March and October, 1903, at Looe; Jan., 1916, at Plymouth and on Cornish coast; and Jan., 1921, at Bude; and in NATURE for July 26, 1924, there is a record by Herdman of its occurrence at Port Erin. One of us also remembers its occurrence in large quantities at Newquay in January, 1922, which was probably due to prevalent southerly winds.

This summer *Velella* has again arrived in large numbers. In the second week in September large specimens were being washed up on the Fistral Beach at Newquay, Cornwall, and their presence was recorded about the same time at Padstow.

In the south-west of Ireland great numbers of fresh specimens were seen in August on the Kerry shores of the Kenmare estuary and with them were found shells of the pelagic mollusc, *Ianthina*, with the soft parts decomposing. Miss M. Delap informs us that in Valentia Harbour enormous swarms of *Velella* have been seen this year. *Ianthina* has been plentiful and lepadid barnacles of several species, attached to feathers, ashes and other floating objects, have been washed ashore.

This year also the pelagic tunicate *Salpa fusiformis* was being caught in numbers in the waters of the English Channel off Plymouth during September; this is a species the occurrence of which in these waters is spasmodic and which appears in quantities at intervals only of several years.

F. S. RUSSELL.

Marine Biological Association,
Plymouth.

STANLEY KEMP.

"Discovery" Committee,
Colonial Office,
Sept. 23.

Bacterial Enzymes in the Purification of Sewage

FROM experiments carried out at the London School of Hygiene and Tropical Medicine, in connexion with the programme of the Water Pollution Research Board of the Department of Scientific and Industrial Research, we have come to the conclusion that the purification of sewage is essentially a matter of bacterial enzymes—whether associated with living or dead bacterial cells appears to be immaterial—and mainly of oxidation-reduction enzymes. Although not excluding from some part in the process such agencies as colloidal flocculation, sedimentation and adsorption, or ruling out the possibility of some step in the purification being due to the agency of other enzymes such as proteases, lipases and carbohydrases, we nevertheless believe that the essential step in the purification of sewage is due to the agency of the bacterial oxidation-reduction enzymes.

We have shown that the uptake of oxygen by crude sewage will not take place if the latter be first sterilised by heat or by filtration, provided that sterility is maintained throughout the period of test. If, however, a small seeding of crude sewage or a small inoculum of certain bacteria be introduced into the sterile sewage a rapid uptake of oxygen results. If the seeding be first boiled no oxygen uptake follows. Certain other bacteria do not bring about the absorption of oxygen when introduced into sterile crude sewage in small numbers but if large concentrations of these organisms, washed free from contaminating media, be introduced vigorous oxygen uptake results, although the organisms do not appear to multiply. The necessary controls give negative results. That bacterial enzymes can effect the absorption of oxygen in the presence of crude sewage independently of the growth of the organism can

be shown by treating a suspension of washed *Pseudomonas fluorescens* cells with formaldehyde so that the suspension is sterile whilst its indophenol oxidase and the dehydrogenases remain active. If such a suspension be introduced into sterile sewage, uptake of oxygen results although no living bacterium can be demonstrated to be present at any time throughout the experiment.

We have further shown that sewage sludge (whether this be taken from the sedimentation tank or the humus tank) or activated sludge is enzymatically active, possessing both oxidases and dehydrogenases. Crude sewage itself, even when sterilised, acts as a substrate for the sludge dehydrogenases, whereas a good sewage effluent acts in the reverse manner, namely, as a hydrogen acceptor in the presence of the sludge and under suitable conditions. That the oxidase appears to be important is supported by the fact that the purification of crude sewage in the presence of activated sludge is inhibited by the presence of $M/1000$ potassium cyanide even when vigorous aeration proceeds. Experiments with five per cent urethane, which similarly inhibits purification of sewage on aeration with sludge, tend to support the contention that dehydrogenases play a part in sewage purification. Purification, as judged by nitrite or nitrate production, is not effected by agitating crude sewage with activated sludge in the absence of air or when the sewage is aerated with air in the presence of boiled sludge.

It is proposed shortly to publish elsewhere some of the experimental evidence in support of our tentative thesis, namely, that the most important factor in sewage purification is a series of catalysed oxidation-reduction reactions determined by bacterial enzymes, present in either living or dead bacterial cells, or liberated by them into the fluid of the reacting system.

W. R. WOOLDRIDGE.
A. F. B. STANDFAST.

London School of Hygiene
and Tropical Medicine,
Keppel St., W.C.1,
Oct. 4.

Light as a Factor in Reproductive Periodicity

IN a letter to NATURE[1] I observed that the culture of diatoms in polarised light would be an interesting piece of research. Later, I placed a culture in a small tube in the path of light from a Nicol prism, and a similar tube using the same culture medium, in ordinary daylight: at night, light from the sky was admitted as in the day. The rate and prolificacy of reproduction were approximately the same. It appears from this that it is the length of the period of exposure, and the intensity of the light which are the chief factors; the polarisation of the light is of little importance. In this case it looks as though reproduction at night has no connexion with lunar periodicity.

To find the effect of the period of exposure to light, I then started nine culture experiments, using the same medium, and inoculated them with a pure culture of *Nitzschia paradoxa*. Three of them were exposed to day light, three to night light, and three to light from both day and night skies. These experiments were begun on August 14 and discontinued on September 1. The first quarter of the moon was on August 9, and the third quarter on August 24, so that the cultures exposed to the night sky were illuminated by a period of maximum polarisation.[2] To make the periods of exposure comparative, the day and night cultures had twelve hours each in the light, the cover which permitted access of light being changed at 8 A.M. and 8 P.M.

The results obtained were as follows:

Culture (*a*)—night light—216 hours.
Culture (*b*)—night light and day light—432 hours.
Culture (*c*)—day light—216 hours.

In cultures (*a*) no reproduction took place, no brown film spread over the bottom of the Petri dishes, and no mass of individuals could be seen with the microscope. In the cultures (*b*) reproduction occurred to the greatest extent, the brown film of diatoms spreading over the bottom of the dishes in a shorter time and in greater numbers than in either of the other two cases. In cultures (*c*) reproduction occurred, but the visible brown film appeared later, and the number of individuals was obviously less than in case (*b*), which had twice the time of exposure.

From these results it appears that the light 'ration' is very important to diatoms: moonlight alone is insufficient to stimulate reproduction, and photosynthesis must take place. The fact that food is an important factor as well as light in reproduction[3] is as true of these minute cryptogams as it is of birds and mammals.

Furthermore, it seems that polarised light promotes the hydrolysis of starch in the presence of the enzyme diastase.[4] This probably explains the asexual reproduction of diatoms at night. In the daytime photosynthesis takes place, ultra-violet light being the active component of sunlight, and starch is deposited round the pyrenoids of the cells. At night hydrolysis takes place, polarised light, in the absence of ultra-violet light, being the active component of moonlight, and this breaking down of starch is conducive to reproduction. It is quite reasonable to believe that this hydrolysis supplies the energy which stimulates the division of the nucleus.

GRAHAM PHILIP.

128, Westbourne Avenue, Hull.
Oct. 8

[1] Philip, NATURE, 129, 655, April 30, 1932.
[2] Fox, NATURE, 130, 23, July 2, 1932.
[3] Bissonnette, NATURE, 129, 612, April 23, 1932.
[4] Semmens, NATURE, 130, 243, Aug. 13, 1932.

Constitution of Cholesterol

IT is not too much to say that work published this month[1] has resolved all dubieties in regard to the main outlines of the molecular structure of the sterols and bile acids, and unquestionably the Wieland-Dane formula is correct. In addition to the change in the position of the hydroxyl group which was mentioned in my letter of October 8 a further modification of current views is necessary in order to make the pieces of the puzzle fit together. Lithobilianic acid and *iso*lithobilianic acid must be stereoisomerides and not structural isomerides as usually assumed and the seat of this persistent type of isomerism is doubtless C–8 of Wieland-Dane's formula. Thus in a *cis*-series we have lithobilianic acid, dihydrocholesterol, the Abderhalden–Diels dibasic acid; and in a *trans*-series, coprosterol and *iso*lithobilianic acid. Interchange of the isomerides

occurs when a carbonyl group is attached to positions 8 or 9 as in deoxybilianic acid and ketostadenic acid. Stereoisomerism also arises as the result of the disposition of groups round position 5.

Only a minor point of the Wieland-Dane formula remains doubtful, and that is the site chosen for the methyl group in the position common to ring II (bile acids) and ring IV. On biogenetic grounds the other point of fusion of these rings would appear to be preferable, the methyl wandering in that case into a *para*-position in certain reactions in the ergosterol series.

As a corollary to the above the paper mentioned in my earlier letter has been withdrawn.

R. ROBINSON.

Dyson Perrins Laboratory,
Oxford. Oct. 12.

[1] Tschesche, *Annalen*, **498**, 185; 1932. Wieland, Dane and Schönberg, *Z. physiol. Chem.*, **211**, 261; 1932. Wieland, Dane and Malweg, *ibid*, 164.

A New Principle of Time Observation, especially for Determination of Longitude

A MAIN difficulty of accurate time determination is the personal equation of the observer. Although the term 'personal equation' suggests that any trained observer would have a fixed personality, such is not found to be the case; and two observers will differ by different amounts in varying circumstances.

Nowadays personality in time observation is to a considerable degree overcome by the 'moving wire micrometer' with which the transit instruments of observatories are generally equipped. I have heard the statement that by this means the personality of several observers is reduced to fall within 0·02 seconds of time. Experience at the Dehra Dun Observatory, where regular time observations have been in progress for the past six years by means of a transit fitted with a moving wire micrometer (hand-driven), scarcely justifies this; and I should say that the results of the several regular time observers scarcely fall within 0·04 seconds of time.

In field observations the differences are apt to be even greater, for the observer is then subjected to much greater changes of conditions than he is likely to encounter in an established observatory. For the study of the figure of the earth, longitude observations must be made at numerous field stations, and the results are apt to be marred by any personal error which is considerable and yet not constant and determinable.

Some six months ago the idea occurred to me to vary the nature of the observation, as now indicated. Instead of attempting to time the instant of a star crossing a wire in the eyepiece of a telescope by depressing a tappet and thereby making a record on a chronograph, or, with the moving wire micrometer, striving to keep the star intersected for a considerable time during which contacts cause a record on a chronograph, I proposed the following plan. The telescope is fitted with a form of shutter which is operated by the clock. This shutter obscures the star to be observed except for brief periods, controlled by the clock. The duration of the exposure should not exceed the period of persistence on the retina, say 0·07 second; and it has been found convenient to have exposures at intervals of three seconds. The eyepiece is provided with a fixed scale, appropriate to the magnification of the telescope—that on which trials have been made was divided to 0·1 mm. The observation consists in estimating the position of the star on the scale at each exposure. The star appears stationary at each exposure, and the observation is merely the reading of a scale. I cannot see that there is room for personality in the mean of a considerable number of readings well distributed over the scale. The observation is not trying to the observer.

Putting this idea into practice has offered a good many difficulties in an observatory remote from scientific supplies. Apart from the glass scale, kindly obtained for me by Sir Gerald Lenox Conyngham and sent out by air mail, I have had to contrive the other requirements from raw materials. I will not enter further into details than to say that a shutter was first placed in front of the object glass but was soon replaced by a narrow strip close to the glass scale and actuated by an electro-magnet controlled by the clock. Owing to the monsoon, clear skies have been very rare and the observations so far obtained are not sufficiently numerous to warrant final conclusions; but the results do not appear to suggest systematic error.

The application of the method to the prismatic astrolabe and to ordinary theodolites has also been considered, and seems quite feasible. As the method does not require a chronograph it offers considerable advantages for field work in difficult country where lightness of equipment is important, and if further observations confirm its precision it will also be useful for time determination in observatories.

J. DE GRAAFF HUNTER.

Survey of India,
Geodetic Branch Office,
Dehra Dun, Sept. 14.

Variations of Latitude and Great Earthquakes

THE beautiful Japanese chart of variation of latitude which accompanies Prof. Nagaoka's communication to NATURE of October 8 starts many inquiries. The motion was within six feet of swing until upset by the Mindanao earthquake, which started an annual wobble of double that amount. This may throw light on the gyroscopic causes of wobble.

Linked with this inquiry, involving the equatorial protuberance, is the uniformity of rotation. Beside checks on it by moon and planets, which can scarcely be very minute, there is the pendulum check. For that a metal pendulum cannot suffice, for the internal flow of cold metal is so slow that it takes centuries for oxidisable products to reach the surface. Only a stone pendulum can serve the question; for that a beryl cut between the axes of contraction and expansion will give a pendulum independent of temperature.

The elevation of the observing station is also involved, and partly settled by sea level. But there is no uniformity in sea level, as ocean flow will not immediately equalise rainfall and evaporation of the ocean. Suppose twenty feet of water piled up at Karachi by Indus flow; for that to equalise with the dry heat evaporation of the South Arabian Sea, it would make a slope of an inch in five miles; and, if flow varies as gradient, that would take most of a year to reach Aden. This suggests that ocean level may be twenty feet higher permanently at Karachi above Aden. It is only possible to suggest inquiry on these interlinked questions; to find solutions is a task of the future.

FLINDERS PETRIE.

Gaza, Palestine.

Research Items

Totemism among the Karadjeri.—The totemic system and social organisation of the Karadjeri tribe, which inhabits territory around Lagrange Bay, north-western Australia, is described by Mr. Ralph Piddington in *Oceania*, vol. 2, pt. 4. Although the tribe has long been under the influence of the white man, certain elements of the totemic system, such as the increase ceremonies and their associated mythology, retain the more important features of their original elements. Increase ceremonies are associated primarily with the districts in which the ceremonies are held rather than with the individual members of the totems. Not all species have their increase centres located in Karadjeri territory, but all important natural species have increase centres somewhere. There are certain prescribed forms for the ritual, though these are not so circumscribed as among the Aranda. The ceremonies are usually performed once a year only, and, if the species appears at one season only, generally just before it becomes plentiful. If the ceremony is associated with perennial foods, it may be performed at any time. Instructions to the species to become plentiful are uttered by the performers as they carry out the ritual, the districts in which it should become plentiful being named in succession. The places named are those in which the species are actually found. At many of the increase ceremonies decorations are worn, such as powdered charcoal, red ochre, white mud, white down, and blood from a human being, taken from the fore-arm by a pointed bone from a wallaby's leg, at a ceremony of which no woman should be a witness.

Ancient Hindu Temples in Burma.—The history and cult of the only Hindu temple in Burma now extant, the Nat-Hlaung temple, Pagan, is discussed by Nihar Ranjar Ray in a communication to the *Indian Antiquary* for September. It would appear that the temple was built not for housing figures of the Buddha, but for statues of deities inferior to him—Hindu figures of the different incarnations of Viṣṇu. According to tradition the temple was founded by king Taung Thugyi (A.D. 931–964); but more probably, and in accordance with another tradition, it was founded by Anaorahta, who flourished in the last half of the eleventh century, even though he was an ardent adherent of the southern Sinhalese school of Buddhism, under the influence of the Brahmanas, who were prominent at the Pagan court. The figure of the main deity of the temple once stood in a niche in a square obelisk in the centre of the interior; but after lying on the floor for long it was removed, and is now in Berlin. It was a seated image of Viṣṇu, of which the lotus throne rests on the bird Garuda posed ready to fly. The god is elaborately ornamented from head to ankles. The bird differs from other representations in Burma. It shows a short stunted human bust resting on two heavy rounded feet. A peculiar feature of the figures of the ten niches on the outer walls of the temple, is that of the seven which still remain, only four are avatars of Viṣṇu, while of the other three, one is identified as the image of Sûrya. It is of the south Indian variety. In the Vedas Sûrya is identified with the sun and is intimately related with Viṣṇu. The idea that Viṣṇu is the sun appears in the worship of the sun as Sûrya-Nârâyaṇa.

The Inheritance of Goitre.—Various hypotheses have been put forward to explain the inheritance of goitre, which is well known to be endemic in regions where the soil waters have a low iodine content but to occur sporadically elsewhere. Dr. C. B. Davenport (Carnegie Inst. Publ. No. 428) has recently made an investigation of goitrous families in a mountain valley in western Maryland. The difficulty of drawing a line, particularly in women, between functional and pathological enlargement of the thyroid, introduces some uncertainty into the results. Since many individuals in goitrous regions escape the disease while some in other areas develop it, the threshold for iodine intake and the efficiency of the thyroid must vary in different families. Dr. Davenport has compiled a number of pedigrees, and from their analysis reaches the conclusion that for the appearance of goitre two genetic factors are necessary, one dominant and sex-linked, the other dominant but not sex-linked. This hypothesis accounts for the well-known excess of females with goitre, and also for various relationships found among the offspring when one or both parents are goitrous. How widely this hypothesis is applicable can be determined by testing it with other pedigrees.

X-Ray Analysis of Teeth.—The hardness of teeth, like that of bone, is due to the deposition, in the enamel and dentine, of a salt (or salts) of calcium and phosphorus. Previous X-ray investigations have indicated the probability that these elements are deposited in the form of apatite. J. Thewlis (*Brit. J. Radiology*, **5**, 353; 1932) has recently confirmed this conclusion, in an X-ray analysis of the enamel and dentine of both human and canine teeth. The rays are more heavily absorbed by the enamel than by the dentine, due to the greater proportion of organic matter in the latter. From density determinations it appears that there is about five per cent of organic matter in the enamel but forty per cent in the dentine. The human tooth contains slightly less than the canine. It was also found that the crystallites of the dentine, in both types of teeth, are randomly oriented: the enamel crystallites, however, have one direction in common but are otherwise randomly oriented. This direction makes an angle of 20° with the normal to the tooth surface in human teeth and is coincident with the normal in canine teeth. There is a possibility that the immunity of dogs' teeth to caries may be related to the arrangement of the crystals of apatite in the enamel. Thewlis's experiments failed to disclose the presence of any other crystalline constituent.

Cytology of Spinning Glands.—St. Wajda (*Bull. Internat. Acad. Polon. Sci. et Lettres*, No. 2, Bd. II., 1931) has investigated the cytology of the spinning glands of the larvæ of the trichopterous insect *Anabolia*, and has shown that, as in the spinning glands of other insects, the nucleolar substance plays an important part in the formation of the secretion which, he states, may be produced in four different ways. (1) The nucleolar material may be extruded from the nucleus into the basal part of the cell; there it stains with acid dyes more weakly than the nucleoli, and forms a sort of pro-secretion which later

breaks up into spherules, and these lie for a long time in the cell plasma, but later increase in size at the expense of the cytoplasm and are finally passed into the lumen of the gland. (2) The nucleolar substance may be expelled from the nucleus into the cytoplasm, where it lies in large vacuoles, and from this eosinophilous material small secretion particles pass from the cytoplasm into the lumen of the gland —in this case the secretion arises directly from the nucleolus. (3) Fragmentation of the nucleolus occurs, and the pieces lie each in a vacuole and become changed by swelling and pyrenolysis into the spinning substance. (4) Pieces of chromatin change from basophile to eosinophile and become transformed into the spinning material. The nucleolar substance therefore plays the most important part in the production of the spinning secretion, as is the case in other insect larvæ previously investigated, but there is no production of the secretion in the cell plasma such as takes place in the larvæ of Myrmeleonidæ and Hymenoptera. This may be correlated with the different chemical constitution of the secretion in the Trichoptera, which 'sets' under water.

Metabolism of Potatoes affected with Leaf-Roll.—Leaf-roll of potatoes is perhaps the most serious of the so-called degeneration diseases. It has been recognised for many years that the causal virus produces an accumulation of starch in the leaves and hinders its translocation to the tuber. The cause of this hindrance forms the subject of a very extensive study by E. Barton-Wright and A. M'Bain ("Studies in the Physiology of the Virus Diseases of the Potato: A Comparison of the Carbohydrate Metabolism of Normal with that of Leaf-Roll Potatoes". *Trans. Roy. Soc. Edin.*, vol. 57, Pt. II, No. 11, 1931-32). It was found that sucrose is the sugar of translocation in healthy plants, whilst carbohydrates are removed as hexose in leaf-roll potatoes. The seasonal variation of starch content in leaf-roll tubers has also been studied, and the bearing of these factors on tuber formation is discussed. Two varieties of potato have been used for the experiments—'Arran Victory', which is not much affected by leaf-roll, and 'President', which is attacked very severely by the disease.

'Tea Yellows' in Nyasaland.—A communication from the Department of Agriculture of the Nyasaland Protectorate (Bulletin No. 3, new series) records a successful piece of work on the etiology and control of the 'yellows' disease of the tea bush, which has troubled planters in Nyasaland for many years. This work, done by Dr. H. H. Storey, of the Agricultural Research Station Amani, Tanganyika, and Mr. H. Leach, mycologist to the Nyasaland Department of Agriculture, leaves little doubt that 'tea yellows' is a deficiency disease due to lack of sulphur in the soil and in the plant. An experiment, started in 1927, showed that the application of ammonium sulphate was very effective in restoring the health of severely diseased bushes, and this was followed up by a series of field tests with fertilisers containing sulphur and not containing sulphur, which showed that both prevention and cure are effected by the sulphate part of the fertilisers. Treatment with ground sulphur was also found beneficial. These results were corroborated by growing tea seedlings with their roots immersed in distilled water containing all the essential plant foods, and in solutions from which one of these plant foods was absent. The seedlings grown in the solution without sulphur developed the exact symptoms of 'yellows' disease even down to the scorching of the young leaves. Chemical analysis of leaves from diseased bushes showed a deficiency in sulphur, and mycological investigation indicated that the fungus *Rhizoctonia bataticola*, which is found on the roots of diseased plants, is not the causative agent, but invades the plant after its health has been sapped by the disease. The control measure now recommended is to apply ammonium sulphate or potassium sulphate in a minimum dressing of 1 oz. per old plant or ½ oz. per new plant, or sulphur at the rate of ¼ oz. or ⅛ oz., respectively. The use of kraal manure, which is rich in combined sulphur, is also advocated.

Swedish Topography.—A detailed study of the recent geology of the Stockholm region in its relation to the existing topography is contained in a paper by Prof. G. de Geer entitled "Stockholmstraktens Kvartärgeologi" (*Sveriges Geologiska Undersökning*, Sev. Ba. 12). It is accompanied by a large-scale coloured geological map of the area showing the surface geology, and much of the paper consists of a discussion of the relations to one another and the sequence of the moraine strata. The morphology of the region is shown to be partly determined by shatter belts and this feature is particularly noticeable in the area lying to the south of the inlet joining Lake Mälar to the Baltic. This inlet, some forty metres deep, is bordered on its southern side by a horst rising comparatively steeply to sixty or even seventy metres. This horst, like the rest of the area, was once covered by Cambro-Silurian deposits. It was then faulted downwards and so its covering rocks were better preserved than in surrounding regions. Subsequent elevation then occurred and gave the present position. The paper is provided with summaries in English of several of its sections.

Scattering of X-Rays by Amorphous Media.—The *Physikalische Zeitschrift* for Aug. 15 contains two papers dealing with the scattering of X-rays by 'amorphous' media. In the first, by Menckc, the scattering is studied in the 'atomic' liquids mercury and gallium, and in carbon tetrachloride. A filtered beam of X-rays falls at a small angle on the liquid surface, and the scattered intensity shows periodic variations with angle. From these one may deduce the structure of the liquid as expressed by a curve showing the relative probability of various interatomic separations. The distribution is similar to that obtained by shaking up two marked balls in a lot of similar balls. The case of carbon tetrachloride is more complicated, and it appears that the scattering cannot be explained by assuming molecules oriented at random. In the other paper, by Ehrhardt, the shapes of the molecules (1,1) and (1,2) $C_2H_4Cl_2$ and (1,2) $C_2H_2Cl_2$ are studied by X-ray interference patterns obtained from the vapours. The results show the distortion of the 'tetrahedral' linkages when chlorine molecules are linked to carbon atoms, the atomic separations in the *cis* and *trans* forms of (1,2) $C_2H_2Cl_2$ and the structure of (1,2) $C_2H_4Cl_2$ as a rotational oscillation around a stable *trans* form. The paper is an interesting example of the application of X-rays to the structure of simple organic molecules.

Scattering of Light by Argon and Methane.—Rayleigh and others have found that the light scattered transversely when a beam of unpolarised light passes through argon is incompletely polarised.

The incompleteness is usually explained by assuming that the molecules behave as anisotropic electric dipole radiators, but it is also possible to explain it on the assumption of electric quadripole radiators or of magnetic dipoles. S. Parthasarathy has described (*Indian J. Phys.*, July) an experiment designed to test this point. The anisotropic dipole view alone requires that the light scattered in the plane of the electric vector from a beam of plane polarised light be unpolarised. The gases were illuminated with a plane polarised beam and the track was photographed through a double image prism by a lens of aperture F:1. A 48-hour exposure was required. The images showed that the light was unpolarised as required by the anisotropic dipole theory. A similar result was found for methane.

Free Organic Radicals.—Rice, Johnston and Evering (*J. Amer. Chem. Soc.*, Sept.) have presented experimental evidence for the decomposition of organic compounds into free radicals by heat. Paneth had previously shown that the vapour of lead tetraethyl, $Pb(C_2H_5)_4$, when mixed with an indifferent gas and passed through a heated tube, decomposed with the formation of free ethyl radicals, since the decomposed gas would remove lead mirrors from a colder part of the tube to form tetraethyl lead once more. The present authors show that a condensable gas such as steam or carbon dioxide may be substituted for the permanent gas, and that a great variety of organic compounds when heated in the range 800°–1000° decompose into free radicals, so that by removing the products rapidly from the furnace, the free radicals formed can be combined with many different metals. Acetone gives only methyl groups; propane gives 80 per cent methyl and 20 per cent ethyl; and butane gives 70 per cent methyl and 30 per cent ethyl. The half-life of the radicals so obtained is 1×10^{-3}–2×10^{-3} sec., as compared with 6×10^{-3} sec. obtained by Paneth and his co-workers. The rate of disappearance does not follow either a first order or a second order equation very well. The temperature coefficient of the decomposition into free radicals, in the case of acetone, was approximately the same as the temperature coefficient of the ordinary thermal decomposition.

Astronomical Topics

Astronomical Notes for November.—Venus and Jupiter are conspicuous morning stars. Venus is now more than a unit from the earth, but three quarters of the disc is illuminated. Mars is also a morning star, near Regulus on November 10; but it is still too distant for useful observation. Uranus is well placed for observation in Pisces, and is observable nearly all night.

Several occultations of stars by the moon are observable in London. A sixth magnitude star disappears at 9^h39^m P.M. on November 8. The Pleiades are occulted at the end of November 13 and beginning of November 14, but the moon is only 18 hours past full. Disappearances occur at 10^h30^m, 10^h53^m and 11^h4^m P.M. Re-appearances (at the dark limb) at 11^h22^m (angle 197°), 0^h6^m (angle 274°), and 0^h26^m (angle 241°). Regulus is occulted on the morning of November 21; disappearance 7^h51^m A.M.; re-appearance 8^h51^m (angle 274°). The angles are measured from north point through east.

A good display of the Leonid meteors is likely to occur this year, but it is impossible to predict what longitudes on earth will be most favoured; the most likely time of maximum is in daylight on November 16, but watch should be kept for two or three nights preceding and following this. The Astronomer Royal has requested the Directors of Kodaikanal and Helwan Observatories to telegraph to the B.B.C. if they see a rich shower. The B.B.C. will broadcast the telegrams if they arrive before the stations close down. The radiant (near Gamma Leonis) does not rise until nearly 11 P.M., so watch need not begin until then. Tempel's comet, associated with these meteors, may also be detected in November; search ephemerides are given in the B.A.A. Handbook for 1932 and (with shorter time intervals) in B.A.A. *Journal*, vol. 42, No. 10. The earth on November 16 is only half a million miles from the comet's orbit.

The minor planet Vesta is in opposition on November 22, and is visible in a binocular, being brighter than mag. 7. An accurate ephemeris is given in the B.A.A. Handbook for November; the following will probably suffice to find it:—

	R.A.	N. Decl.
Nov. $5^d\ 0^h$	$4^h\ 14{\cdot}8^m$	12° 42′
13	4 7·2	12 27
21	3 58·8	12 15
29	3 502·	12 8

Vesta is 5′ south of λ Tauri on the evening of November 22. Conveniently observable minima of Algol occur on November 3, 9^h P.M., November 6, 6^h P.M., November 23, 11^h P.M., November 26, 8^h P.M.

Radial Velocities of Stars, Nebulæ and Clusters.—Vol. 18 of the Lick Observatory Publications consists of a useful catalogue of radial velocities compiled by Joseph Haines Moore. All the results obtained at the Lick Observatory and at its southern station in Chile are included, also those at eighteen other observatories, systematic corrections being applied to all classes of observations for which their determination is possible. The results of the separate observatories are given for each star, also an adopted value with its estimated probable error. The stellar portion of the catalogue occupies 199 pages with an average of about thirty stars on each. Then follows a short catalogue of velocities of 133 gaseous nebulæ; these are all galactic objects except 18 in the Magellanic Clouds. Another list includes the results for 18 globular clusters, mainly obtained by V. M. Slipher at the Lowell Observatory. Finally there are radial velocities for ninety extra-galactic nebulæ, mainly obtained at the Lowell Observatory and at Mount Wilson. The spectral shift is expressed as radial velocity, but with a note that this is only done for uniformity with the rest of the catalogue, not asserting that this is its true interpretation. The velocities are nearly all positive; there are the well known exceptions of the Andromeda nebula and its two companions, also M. 33 and N.G.C. 6822. The largest recessional velocity is 19,700 km./sec. for a nebula in Leo, R.A. (1900) $10^h22{\cdot}0^m$ N.Decl. 10° 56′.

The Structure of Cellulose and Related Substances

THE discussion arranged by Section B (Chemistry) of the British Association on September 2, on the constitution of polysaccharides with special reference to fibres, was perhaps a happy example of what such discussions should be and disarms some of the criticism which has recently been levelled against the programmes of certain of the sections. The results of recent researches in this difficult but fascinating field were presented for the most part in a lucid manner which rendered them intelligible to scientific workers generally and not merely to specialists in this particular field. For this some credit must undoubtedly be given to the formal arrangement of the discussion; the gap left by Prof. M. Bergman, who was unable to be present, was well filled by Prof. L. Zechmeister.

Prof. W. N. Haworth opened the discussion with a survey of the development of our knowledge of the constitution of polysaccharides in which the fundamental contribution of the work of the Birmingham school in establishing the structure of the mono- and di-saccharides was emphasised. The structure of cellulose, for example, rests ultimately on the constitution assigned to the disaccharide cellobiose, and the mutual linking of β-glucopyranose residues in a chain through positions 1 and 4 of the glucose molecules is the fundamental principle of the modern cellulose structure. Recent work by Haworth and Machemer has indicated that information on the approximate length of the chains and as to whether they are open or closed can be obtained by a study of the fully methylated derivative of cellulose, obtained by methylation under very mild conditions in which no important degradation or decomposition of the macro-molecules occurs. Since if the macro-molecule is in the form of an endless chain, each glucose unit ultimately yields 2 : 3 : 6-trimethylglucose, while if the chain terminates one of the terminal groups yields a molecule of tetramethylglucose, and a quantitative separation of the tri- and tetramethylglucose is possible, the hydrolysis method can be used to determine the structure of the chain. The formation of 0·6 per cent of tetramethylglucose accordingly indicates a mean average length of about 100–200 glucose units for the terminated chains in cellulose. The average molecular weight of 30,000 thus indicated is in good agreement with values obtained from X-ray data and by the use of Svedberg's ultra-centrifuge method. Values obtained by this method for the chain length of a long series of cellodextrins are in excellent agreement with those obtained by viscosity measurements or by determination of the iodine value.

Prof. H. Staudinger then described the viscosity method of investigating the nature and size of the colloid particles of cellulose and related substances. An exhaustive study of synthetic polymeric substances of known constitution parallel with that of the 'polymer homologous' series of degradation products of cellulose showed that in sufficiently dilute solution the relation between their molecular length and viscosity in solution is expressed by the viscosity law:

$$\eta/c = K_m . M$$

where η is the specific viscosity, c, the concentration, K_m a characteristic constant for each polymer homologous series and M the molecular weight. In these solutions as in solutions of cellulose in Schweizer's reagent or of cellulose acetate or nitrate in organic media the colloid particles are the molecules themselves and do not have a micellar structure. The 'polymer homologous' series of degradation products of cellulose obey the same law and these methods lead by extrapolation to a molecular weight of 120,000 for cellulose in Schweizer's reagent, 750 glucose residues being combined in one molecule. The molecules are long threads which in one dimension are 500 times longer than in the other two. Viscosity relations also afford evidence of the presence of a 6-carbon atom ring in the glucose residues of cellulose.

Prof. L. Zechmeister's paper discussed the unexpected behaviour towards enzymes of polysaccharides of comparatively small chain-length (4–8 glucose units). Dr. Zechmeister suggested that in enzyme reactions the length of chain of the reacting molecule as well as the character of the groupings present is important. The field of investigation thus outlined is of the greater interest in view of Mr. W. T. Astbury's suggestion of the existence of a fundamental relation between protein chains and polysaccharide chains.

Dr. E. L. Hirst then discussed the question of the molecular structure of starch and its allied products glycogen and inulin. In starch the mutually linked glucose residues are united by α-glucosidic linkings in contrast with the β-glucosidic linkings of cellulose, while the α-linkings of starch do not readily give a straight chain pattern but favour the formation of interlocked aggregates of the macro-molecules, which in presence of water are hydrated with formation of micellar solutions. Recent work has shown that the differences between amylose and amylopectin do not depend on the phosphorus content. On careful acetylation and methylation the special characteristics of each modification are retained and since the purified and fractionated methylated derivatives both yielded 5 per cent of tetramethylglucose, the macro-molecules of amylose and amylopectin both consist of terminated chains of 24–30 glucose units (mean average mol. wt. 4000–5000) and the differences between amylose and amylopectin depend on hydration and interlocking of the macro-molecules and on micellar structure. Glycogen is built up on a plan similar to that of starch and differs from amylose in having a macro-molecule containing only 12–14 glucose residues in the chain. Similarly inulin has been found to consist of a terminated chain of about 30 fructofuranose residues mutually linked through positions 1 and 2, the macro-molecule probably terminating at one end in a reducing group. The corresponding molecular weight (about 5000) is in good agreement with estimates made by direct methods.

Prof. H. Mark gave a critical review of the bases upon which the accepted formula for cellulose rests, and showed how a combination of the chemical methods which had established the structure of cellobiose and the disaccharides, the application of X-ray methods, and the researches of Prof. Staudinger on the nature and size of molecules of colloidal substances had led to a picture of the cellulose molecule and of the arrangement of molecules in the fibre which in many respects may be considered as definitely established. From a detailed examination of X-ray data including data recently obtained by the

application of new methods Dr. Mark described the arrangement of the glucose units in the fibre and of groups of these chains associated as micellar bundles, the length of the chain being about 100–200 glucose residues, in agreement with the value obtained by the chemical methods of the Birmingham school.

The final paper by Mr. W. T. Astbury described the application of X-ray methods in the field of protein chemistry, where again the combination of the results of organic chemistry and physical methods has established the concept of long chain molecules. Protein fibres are built up of polypeptide chains in various states of extension whereas cellulose appears to be laid down in biological structures as fully extended chains. X-ray methods have as yet revealed only two proteins, the fibroin of natural silk and the β-keratin of stretched hair which are in a fully extended state. Since in natural processes the formation of cellulose and other polysaccharides seems to be effected through the intervention of proteins, it is possible that the protein chains may act as a pattern or framework upon which the sugar units are laid down as a preliminary step to their linking together in polysaccharide chains. It is an interesting point that the chief longitudinal spacings of muscle and of unstretched hair are almost equal to the length of a glucose residue as it occurs in cellulose and the fact that the crossed-cellulose chains of the wall of *Valonia ventricosa* are laid down according to a definite plan indicates that they have been built on a net-work pattern in the underlying protoplasmic layer.

Sixth International Congress of Genetics

NOTWITHSTANDING the small number of European delegates attending, the International Congress of Genetics held at Cornell University, Ithaca, New York, on August 24–31, was a marked success. This was mainly owing to the large amount of preparatory work undertaken by the Organisation Committee, the Executive Council and the Local Committee. Although many papers were not read in the absence of their authors, the programme was still overcrowded, and the volume of proceedings containing the abstracts of papers and descriptions of exhibits runs to more than four hundred pages. The exhibits alone would have furnished ample material for a busy week. Numerous laboratories in several buildings were devoted to exhibits, in which cytological demonstrations played a prominent part; but they included also living and dried specimens illustrating genetic experiments with fungi, liverworts, mosses, ferns, numerous cereals, economic and other plants, as well as collections of varieties of maize and vegetables and numerous floricultural exhibits. The animal exhibits included *Drosophilia* and *Sciara*, Lepidoptera, Orthoptera, bees, aphids, *Gammarus*, tunicates, echinoderms, molluscs, fishes, rats and mice, foxes, pigeons, guinea-pigs, and all the domestic animals, many of the latter as living specimens.

FIG. 1.—Genetic garden at the Sixth International Congress of Genetics, Ithaca

A unique feature of the Congress was the genetic garden (Fig. 1), contributed to by geneticists who had sent seeds from many parts of the world. Here were demonstrated and compared side by side the various forms, hybrids and mutations, of *Zea*, *Œnothera*, *Nicotiana*, *Primula*, *Antirrhinum*, *Pharbitis*, *Helianthus*, *Pisum*, etc. A special feature arranged by Prof. Emerson was the display of the numerous mutations of *Zea* in their proper order in the ten chromosomes, as determined by linkage investigations. A chart also showed the loci of more than eighty genes in maize.

The cytological demonstrations were so many that, although a hundred microscopes must have been in use, each exhibit could only be set up for one afternoon. The work on maize chromosomes by the Cornell group was the basis of excited discussions. The great detail of chromosome structure and behaviour observable in maize is in marked contrast to *Drosophila*, although here, too, numerous cases of visible translocations were demonstrated.

The morning sessions were devoted to general papers grouped under such topics as the nature and cause of mutations, the interrelations of cytology and genetics, the genetics of species hybrids and the contributions of genetics to the theory of organic evolution. On the afternoons of the last three days the Congress divided into six sections for the reading of a very large number of more specialised papers. The grouping of these was under such topics as general genetics, cytology, animal genetics, human genetics, methods and technique, and genetics and pathology. Numerous papers were concerned with *Drosophila* and a number bore on chromosome structure, especially in relation to crossing-over.

The presidential address by Prof. T. H. Morgan was on "The Rise of Genetics".

The evenings were taken up with informal group conferences on such subjects as the nature of the gene, poultry linkage work, mice, maize, size valuation, fish genetics and human genetics. Motion picture films were shown of the developing fowl blastoderm, living cells in mitosis and sexual reproduction in *Mucor*.

On the last day of this crowded week the Congress met at the New York Agricultural Experiment Station, Geneva, where the papers, exhibits and demonstrations related mainly to fruit and vegetable breeding and agricultural bacteriology. This was followed by excursions to New England and Canada, while others dispersed to see the solar eclipse of August 31.

The Congress must have been a great stimulus to everyone who took part in it, for it served to show that genetics is still a rapidly expanding field, with innumerable practical applications in plant and animal production and also with a widening basis in relation to general biological theory. Many papers showed how technical is becoming the investigation of the *Drosophila* mutations and the production of mutations in many organisms by X-rays. Perhaps the most general advance indicated since the last Congress in 1927 is the increasing intimacy of relationship demonstrated between chromosome structure and genetic behaviour.

The British delegates included Prof. Ruggles Gates and Prof. F. A. E. Crew, representing the Government, and Dr. R. A. Fisher, Prof. J. B. S. Haldane, Dr. C. C. Hurst, Dr. C. D. Darlington, Dr. Honor Fell and Dr. John Hammond.

Progress of Aeronautical Research*

THE Aeronautical Research Committee's report of the year's work reflects the general slowing up of all progress consequent upon the reduction of expenditure, in that there has been little new research undertaken, but a good deal of cleaning-up of outstanding detail has been accomplished.

New experimental apparatus has received a good deal of attention. At the National Physical Laboratory the new compressed air tunnel is in working order, and an early obsolete tunnel is being rebuilt with an elliptical cross section and a much higher speed. The R.A.E. has the new vertical free flight tunnel in operation. A modification giving an increase of speed in the new open jet tunnel, and a new high-speed water tank are both practically finished. A 24 ft. full scale tunnel is in hand, and should be working by the end of 1933.

The work on spinning has been collected and collated, and design rules for ease of recovery from, or for complete avoidance of, spinning, have been developed. An interesting sideline in these experiments has been the development of wing-tip parachutes, which can be released at will to act as brakes on the spinning machine. It is suggested that these will reduce the danger when carrying out spinning tests on new type machines, the properties of which in this respect have to be found by actual experiment.

Further research on 'buffeting'—an effect first brought into prominence by the failure of a German D.V.L. aircraft over Meopham—suggests a remedy which in cases appears to clash with that needed to cure spinning. Buffeting can be minimised by keeping the tail plane "in the lowest practicable position in relation to the wings", while for the avoidance of spinning it is necessary to raise the tail plane with respect to the fin and rudder. These contradictory requirements appear to indicate a disadvantage of the low-wing monoplane which has not previously been realised.

The problems of stability and control are adequately met by the development of various forms of slots and interceptors, and as a result of the intensive investigations upon these questions the report suggests that there is now sufficient information in existence to enable designers to achieve a sufficient degree of safety by "correctly shaping and arranging the wings and tail organs without using additional mechanisms on the wings". Similar remarks are made with regard to wing or tail flutter. Airscrew flutter is unfortunately not so completely understood, and further investigations into this are proposed.

Interference between various adjacent parts of an aeroplane has now been dealt with up to the stage at which it is possible to isolate the various causes and deal with them separately.

A new term, "spoiling drag", has been introduced to indicate an additional drag due to the rotary motion of the airscrew slip stream upon the bodies in it. Suggestions for counteracting it with radial vanes are offered, as the result of wind tunnel experiments.

Attention is directed to the very rapid increase of size of sea-going aircraft during the last few years and to the necessity of keeping pace with this in research, as many new problems due to increase of size are arising. For example, the change of hydrodynamic pressures on hull bottoms during take-off and alighting are giving rise to problems upon the elasticity of the material of the hull plating.

The effect of accelerations imposed upon the aircraft by gusts is now being taken up. Vertical gusts with velocities up to 30 ft. per second have been recorded under the edges of certain types of clouds, and there is reason to suppose that even larger ones may be found in stronger winds. Statistical recording accelerometers are being developed for use on aircraft operating over established air routes. On the theoretical side the effect of accelerations on the aerodynamical characteristics of the various parts of a machine is being investigated.

The position with regard to research on aero-engines is peculiar in that it appears that there is little scope for further radical improvement in the present weight of 1·5 lb./H.P. with a fuel consumption of 0·5 lb./B.H.P./H.P. Any further reductions could only be made at the expense of reliability and length of life, but attention to details, such as cooling methods, that allow the engine and aeroplane as a whole to have a better streamline form, will possibly result in an improved performance being obtained for the same power and weight of engine. It is suggested that there is a greater probability of reducing this drag by, say, 20 per cent, than of cutting down either weight or fuel consumption by a similar amount.

In theory, fuel economy is being hindered by unsatisfactory induction pipe distribution in multi-cylinder engines, and the absence of a control of fuel-air mixture production which automatically adjusts itself to changing air conditions. Direct injection of fuel into the cylinders would remove both of these weaknesses.

Work on compression-ignition engines is progressing both with engines and fuel. It has been decided that the two-stroke direct spray type holds

* The Aeronautical Research Committee Report for the Year 1931-32. H.M. Stationery Office, 2s. net.

out the best possibilities of success for aircraft work, and a new experimental unit is being built. Fuel oil has been found to respond to various doping mixtures, and a small addition of ethyl nitrate renders inferior oil superior to the highest grade when undoped.

The report appreciates the fact that there has been a considerable increase in the amount of research work done at the universities. Direct aeronautical research is now being carried out at Bristol, Cambridge, Glasgow, Imperial College (South Kensington), Manchester and Oxford.

University and Educational Intelligence

CAMBRIDGE.—Mr. N. Dean of Trinity Hall has been appointed University lecturer in estate management.

The Appointments Committee of the Faculty of Biology 'B' gives notice that it will shortly proceed to appoint a University lecturer and a University demonstrator in biochemistry. The duties will commence on January 1, 1933. Particulars as to stipend and duties may be obtained from Sir Frederick Gowland Hopkins, at the School of Biochemistry, to whom applications should be sent on or before November 9.

The degree of M.A. has been conferred on Prof. R. S. Hutton, of Clare College, Goldsmiths' professor of metallurgy.

In accordance with its usual practice, Trinity College announces the offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October next as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year if the pecuniary circumstances of the successful candidate require so large a sum. The College also offers, as usual, dominion and colonial exhibitions to students of dominion and colonial universities who wish to go to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These exhibitions are of the titular value of £40, but their actual value is such sum (if any) not exceeding the titular value as the College Council may from time to time hold to be justified by the exhibitioner's financial circumstances. If it is made clear that the financial need of an exhibitioner cannot possibly be met by the payment to him of the full amount of his titular emolument, the Council has power, if funds are available, to award him an additional payment. Candidates for the research studentship and the exhibitions must apply through the principal authority of their university, and applications should reach the Senior Tutor (from whom further particulars may be obtained) by July 1, 1933.

WALES.—At a meeting of the Court of Governors of the University College of Wales, Aberystwyth, held on October 19, it was reported that Sir Julien Cahn has promised to provide a sum of £3,000 a year for a period of seven years. This money will be utilised for large-scale experiments on the improvement of poor soils at the Welsh Plant Breeding Station. Principal Stuart-Jones has accepted the invitation of the Council to retain the principalship for another year. Prof. G. A. Schott, professor of mathematics, has been appointed vice-principal of the College.

OXFORD.—On October 18 a decree was passed by Congregation constituting a Committee for Ornithology with the duty of establishing and supervising an Institute of Ornithology. The functions of the Institute, the formation of which was foreshadowed by Dr. F. Homes Dudden, the previous Vice-Chancellor, in his valedictory address, will be to carry out research into problems of ornithology, with special reference to the numbers, distribution, movements, habits and economic status of British birds; to collect, co-ordinate and supply information on these subjects obtained from published sources and from field observers, and to publish the results of its work by means of printed papers, informal instruction, or lectures. The Institute will be independent of any single University department but will work in co-operation especially with the Departments of Zoology and Comparative Anatomy and of Rural Economy. The decree creating the Institute does not come into force until May 1, 1933, and it is one of the functions of the new Committee to select the staff.

THE Council of the Institution of Naval Architects has made the following awards: Parsons scholarship in marine engineering (1932), to Mr. Allan M. Baxter, of Messrs. G. and J. Weir, Cathcart, Glasgow; Denny scholarship in naval architecture to Mr. John R. White, of Macclesfield Grammar School, and the Denny scholarship in marine engineering to Mr. K. F. Leonard, of the Ealing County School, London; Duke of Northumberland prize (in connexion with the 1932 examinations for National Higher Certificates in naval architecture) to Mr. Norman Holey, of the Technical College, Sunderland.

THE superintendence of the work of rural school teachers in the United States of America forms the subject of two recent bulletins, Nos. 6 and 7 of 1932, of the Office of Education. These supplement the studies, recently noticed in these columns (see NATURE of Oct. 15, p. 589), of the present status of the rural school teachers themselves, and afford further evidence of the keen interest now taken in rural education in that country. In "The County Superintendent in the United States" by the professor of rural education, Cornell University, attention is directed to the magnitude and the difficulty of the work of this functionary. While recent improvements in means of communication must have facilitated the inspection of schools in sparsely populated tracts, the task which falls to the lot of the typical superintendent with 145 teachers in 55 schools under his jurisdiction is a formidable one. In addition to supervision he has to attend to problems of finance, buildings and their equipment, pupil classification and progress, curricula, consolidation and transportation, etc. The intrinsic difficulty of these problems is aggravated by the fact that he has to deal with many local boards. Only a minority have a supervisory assistant and only about half have clerical help. In more than half the States the superintendent is elected by popular vote and in these 43 per cent are women and the median salary is 1848 dollars. In the other States, where appointments are made by county boards or State officials, the percentage of women superintendents is 5-18 and the median salary ranges between 2259 and 2773 dollars. An improvement in the salary situation is necessary, we are told, in all the States if the rural schools are to attract and hold professional men and women of ability.

Calendar of Geographical Exploration

Nov. 2, 1841.—Afghanistan and Its Borders

Sir Alexander Burnes was assassinated while acting as political agent in Kabul. Burnes became an interpreter in Surat when only seventeen years of age and developed a keen interest in the history and geography of north-western India and the adjacent countries. In 1832, disguised as an Afghan, he started from Lahore, made his way across Afghanistan to Balkh, thence to Bukhara, Astrabad and Teheran, and across Persia to Bushire. In 1835 he returned to Afghanistan, taking with him John Wood. The latter explored the Kabul River, crossed the Hindu Kush mountains to the Oxus, and explored that river to one of its sources. He gathered much information about the nomad tribes of that region.

Nov. 3, 1924.—The Rio Negro and its Tributaries

Dr. Hamilton Rice made his first air survey in the 1924–25 expedition to the Rio Branco and Uraricoera. Rice's valuable work on the northern portion of the Amazon basin began in 1907, when he surveyed the Uaupes River to its junction with the Rio Negro. Further expeditions in 1912–13, 1917, 1919–20 and 1924–25 resulted in an accurate survey of the tributaries of the Rio Negro and of the river itself to Manaos.

Nov. 4, 1909.—Exploration of Persia

Sir Percy Sykes left Meshed on the second part of his sixth expedition into Persia. These six expeditions were of the utmost importance for the survey of Persia, and filled in many blank spaces on its map. Sykes's travels also threw new light on ancient geography; in this sixth, 1906–10, journey he discovered the site of ancient Nishapur and also of Kishmar a spot connected by legend with Zoroaster.

Societies and Academies

LONDON

Physical Society, Oct. 21.—**F. Twyman**: New apparatus for rapid spectrophotometry of liquids in the ultra-violet. A single exposure, usually of less than 20 sec., results in a set of spectra which embodies all that is necessary for plotting an absorption curve.—**J D. Stephenson**: An experimental study of electrical discharge in gases at normal temperatures and pressures. By an investigation based on corona discharge it is shown that there is a fixed constant, the true breakdown strength of the gas, for all types of gas discharge at normal pressures.—**G. A. Tomlinson**: A new type of pendulum clock. A new method of taking accurately defined seconds signals from a pendulum is described, in which a photo-electric cell is used in conjunction with a special arrangement of multiple slits. This has been developed into a complete free-pendulum system, self-maintained *in vacuo* by means of electrostatic impulses and having a closely governed arc.—**S. E. Williams**: A photographic method of deriving optical constants of the metals. A grating consisting of alternate strips of glass and metal of known dimensions gives diffraction spectra the relative intensities of which depend on the optical properties of the metal and glass. An expression has been found for the relative intensities of the central reflected image and the first principal diffracted image in terms of the reflection coefficients for the metal and glass and the phase change on reflection from the metal surface. By means of a photometric method which is described, the intensity ratio has been measured for two or more gratings of different proportions cut on the one mirror, enabling the deduction of the reflection coefficients and the change of phase. This is done both for light plane polarised in, and perpendicularly to, the plane of incidence, and the approximate Drude formulæ are used to calculate the optical constants. Simultaneous measurements can be made at several wave-lengths if the grating is illuminated with light from a source having a suitable line spectrum.

PARIS

Academy of Sciences, Sept. 12 (vol. 195, pp. 525–532).—**N. Saltykow**: The complete integral of partial differential equations of the second order.—**Pierre Marti**: The possibility of determining the slope of the sea floor by means of acoustic sounding. When the sea floor is level the determination of the interval of time between the sound emission and the arrival of the echo gives the depth. If the sound is powerful, several echos are received and these are separated by equal intervals of time in the case of a horizontal sea floor, but if there is a slope, the intervals of time of the successive echos are not equal, and the exact comparison of these intervals can be used for determining the slope. A formula for this is given.—**V. Hourcq**: The age of the glauconitic limestones of the Antsalova region (Province of Maintirano), Madagascar. It is possible that the limestone represents only the lowest part of the Kimmeridge strata and that the greater part should be regarded as Tithonic.

Sept. 19 (vol. 195, pp. 533–548).—**J. Cantacuzène and S. Longhin**: The experimental transmission of human leprosy to the white rat.—**Louis de Broglie**: An analogy between Dirac's electron and the electromagnetic wave.—**J. Fromaget and F. Bonelli**: Materials from Angkor and some points of the stratigraphy and the geological structure of northern and eastern Cambodia.—**A. Rivière**: Contribution to the study of the Jurassic in the central Elbourz.—**L. Clariond, N. Gouskov and E. Roch**: The ancient series of the country of Skoura (Central Moroccan Haut-Atlas).—**Pierre Marty and Pierre Bout**: The discovery of a layer of fossil plants in the Pliocene formation of Perrier, near Issoire (Puy-de-Dôme).—**Jean Caminopetros and B. Contos**: The transmission of pustular fever to the guinea-pig.

Sept. 26 (vol. 195, pp. 549–564).—**A. Caillon and R. de Fleury**: Casting magnesium: use of a special sand. The addition of ammonium sulphate and powdered fluorspar to the sand used for moulds is recommended on the grounds of low cost for magnesium castings.—**A. Rivière**: The Cretaceous in the north of central Elbourz.—**Jacques Fromaget**: The Caledonian folds of the massif of Fan Si Pan (Tonkin).—**Léon Grigorakis**: The action of ether on the microplant parasites of animal tissue. Factors of virulence, vitality, degradation and mutation.—**P. Cappe de Baillon**: The thermal sensitiveness of the Phasmidæ.—**A. Magnan and Ch. Perrilliat-Botonet**: The relative weight of the motor muscles of the wings in insects—**Jonesco-Mihaiesti, A. Tupa, B. Wismer and G. Badenski**: Acute pseudo-tabetic syndrome resulting from the experimental inoculation of the filtrate of inguinal lymphogranulome (Nicolas–Favre).

SYDNEY

Linnean Society of New South Wales, June 29.—**C. Oke**: Notes on Australian Coleoptera, with descriptions of new species (2). Two new genera and thirty-five new species belonging to various families are described. Probably the most interesting species described belongs to the family Rhysodidæ, and is the first of the Australian species to be recorded as a myrmecophile.—**A. B. Walkom**: Fossil plants from Mount Piddington and Clarence Siding, N.S.W. Specimens from Mount Piddington include *Cladophlebis australis*, *Thinnfeldia Feistmanteli*, possible flowers of *Williamsonia*, and one which may be *Phyllotheca robusta* Feistmantel. From Clarence Siding a fertile specimen of a fern (?) with very long narrow pinnæ and sori of the *Asterotheca* type is described as a new genus. These plants occur near the western margin of the Hawkesbury Series basin, and it is difficult to correlate the horizon since, near the coast, the sandstone series has a thickness of about a thousand feet, but near the western margin the thickness is only about three hundred feet.—**H. L. Jensen**: Contributions to our knowledge of the Actinomycetales. (3) Further observations on the genus *Micromonospora*. A description of sixty-seven strains of *Micromonospora* isolated from Australian soils. They are divided into four species-groups, one of which seems identical with '*Streptothrix*' *chalceæ* Foulerton; the other three are described as new species. These organisms seem to occur most abundantly in neutral to alkaline soils from districts with a low rainfall.—**J. R. Malloch**: Notes on Australian Diptera (31). Certain species of the genus *Prosena* (Tachinidæ) are described, three being new. A key is given for the identification of the species of *Prosena*.

Royal Society of New South Wales, Aug. 3.—**A. R. Penfold**: The chemistry of Western Australian sandalwood oil. Conclusive and confirmatory evidence was submitted that the oil from the roots and butts yielded the best quality of oil for commercial purposes and differed considerably in chemical composition from that obtained from the stickwood. The paper was accompanied by two comprehensive tables setting forth the chemical and physical characters of each individual sample of oil together with the alcoholic bodies obtained from each by treatment with phthalic anhydride in benzene solution on a boiling water bath for two hours, as well as the yields of santalenic acid and santalol allophanate. An examination of the oil obtained from a consignment of butts said to be a fair average of the raw material used in the production of commercial Australian sandalwood oil showed it to contain more than fifty per cent of B-santalol.—**Alma G. Culey**: Ripple-marks in the Narrabeen series along the coast of New South Wales. Numerous exposures of oscillation ripple-marks have been observed over a large vertical range and wide area in the Narrabeen series (lower Triassic), of New South Wales. The dimensions of the ripple-marks and their association with plant remains, worm-burrows, and sun-cracks, point to quiet deposition of the Narrabeen beds in a very shallow, subsiding, fresh-water lake. Comparison of quantitative diagrams, indicating the directions of the ripple-marks and present-day winds, suggests that the planetary wind systems of lower Triassic time were the same as those prevailing now. Hence one may deduce that the poles were in the same position then as now.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 481–523, July 15, 1932).—**Marcus M. Rhoades**: The genetic demonstration of double strand crossing-over in *Zea mays*.—**Jack Schultz**: The behaviour of vermilion-suppressor in mosaics. This factor in *Drosophila* depends on factors outside the mosaic tissues as does vermilion. Its effect seems to be exerted before the onset of pigment formation.—**George C. Vaillant**: Stratigraphical research in Central Mexico. Continuation of the American Museum of Natural History archæological work in the Valley of Mexico. It is concluded that the Teotihuacan culture was not derived from Valley groups of the Early periods, and a ceramic sequence of three periods is arranged. The Mazapan culture is dated as post-Teotihuacan and pre-Aztec.—**David Davidson and Marston T. Bogert**: Isovioluric acid (alloxan-6-oxime). Prepared by action of nitrous acid on isobarbituric acid. It is rearranged by acid, giving violuric acid and by reduction yields isouramil (5, 6-dihydroxycytosine).—**Edward W. Washburn and Harold C. Urey**: Concentration of the H^2 isotope of hydrogen by the fractional electrolysis of water. An experiment is in process at the Bureau of Standards. Meanwhile, spectrographic examination of the residues from the commercial hydrolysis of water showed there was increase in the abundance of H^2 relative to H^1.—**Linus Pauling**: The electronic structure of the normal nitrous oxide molecule. A recalculation of Plyler and Barker's data leads to a value of the moment of inertia which corresponds to a Lewis structure in which the nitrogen–nitrogen bond resonates between a double and triple bond and the nitrogen–oxygen bond between a single and double bond. The structure can be written $N \overset{=}{=} N = O$.—**Harvey Cushing**: Further concerning a parasympathetic centre in the interbrain. (7) The effect of intraventricularly injected histamine. It has been objected to the observations recorded about a year ago that the effects after intraventricular injection of pituitrin and pilocarpine were due to impurities, probably histamine. Examination of the posterior lobe extract used showed it to be free from histamine. Further, intraventricular injection of histamine produces facial pallor rather than flushing.—(8) The comparative effects on gastric motility of intramuscular and intraventricular pituitrin, pilocarpine and histamine. Pituitrin and pilocarpine do not increase gastric acidity as does histamine. When given intraventricularly, both increase motility and lead to retrograde peristalsis and vomiting; intramuscularly, they inhibit gastric peristalsis, but there is also a delayed acceleration of peristalsis with pilocarpine. Intramuscular pituitrin seems to stimulate the thoracolumbar sympathetic apparatus; intraventricular pituitrin appears to have a contrary effect, essentially parasympathetic in character.—**G. A. Miller**: Orders for which there exist exactly four or five groups.—**J. L. Walsh**: On interpolation to harmonic functions by harmonic polynomials.—**A. E. Currier**: Partial differentiation in the large.—**Chester Stock**: Eocene land mammals on the Pacific coast. The Sespe formation in Southern California comprises sandstones, shales and conglomerate. Vertebrate remains in the Simi Valley region in the maroon and green clays and sandstones of the middle division of the Sespe formation include titanotheres, rhinoceroses, artiodactyls (*Protylopus*), rodents (*Paramys*) and others indicative of the Eocene age.

Forthcoming Events

TUESDAY, Nov. 1

CHADWICK PUBLIC LECTURE—(at the Royal Society of Tropical Medicine and Hygiene, 26, Portland Place, W.1.).—Prof. Keilstra: "Hygiene in the Far East", at 5.15 P.M.

INSTITUTION OF CIVIL ENGINEERS—(Opening Meeting). Sir Murdoch Macdonald: Presidential Address, at 6 P.M.

WEDNESDAY, Nov. 2

INSTITUTION OF HEATING AND VENTILATING ENGINEERS—(at the Lecture Room, Home Office Industrial Museum, Horseferry Road, Westminster, S.W.1).—Mr. A. F. Dufton: "Radiant Heat", at 7 P.M. (open to non-members).

THURSDAY, Nov. 3

KING'S COLLEGE, LONDON.—Prof. Martin Knudsen: "Some Aspects of the Kinetic Theory of Gases", at 5.30 P.M. (succeeding lectures on Nov. 10 and 17).

UNIVERSITY OF LONDON—(Semon Lecture at the Royal Society of Medicine, 1, Wimpole Street, W.1).—Prof. Otto Kahler: "The Tonsil Problem", at 5 P.M.

FRIDAY, Nov. 4

INSTITUTION OF MECHANICAL ENGINEERS—(Thomas Hawksley Lecture).—The Right Hon. Lord Rutherford: "Atomic Projectiles and their Application", at 6 P.M.

BRITISH SCIENCE GUILD—(Alexander Pedler Lecture).—Prof. F. T. G. Hobday: "Animals as a National Asset and Responsibility", at Burton-on-Trent.

SATURDAY, Nov. 5

GEOLOGISTS' ASSOCIATION OF LONDON.—Special General Meeting in the Botany Theatre, University College, Gower Street, W.C.1, at 3 P.M.

ROYAL INSTITUTION.—Prof. E. N. da C. Andrade: "Rays and Radiations", at 5.15 P.M.

Official Publications Received

GREAT BRITAIN AND IRELAND

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1432 (T.3099): Single Crystals of Bismuth subjected to Alternating Torsional Stresses. By Dr. H. J. Gough and H. L. Cox. Pp. 25+4 plates. 1s. 6d. net. No. 1434 (T.3163 extd.): Hot Wire and Spark Shadowgraphs of the Airflow through an Airscrew. By H. C. H. Townend. Pp. 10+7 plates. 1s. 3d. net. (London: H.M. Stationery Office.)

Observations of Colour Temperatures of Stars made at the Royal Observatory, Greenwich, in the Years 1926–1932, under the direction of Sir Frank Dyson. Pp. iii+63. (London: H.M. Stationery Office.) 6s. net.

Annals of the Cape Observatory. Vol. 13, Part 3: Discussion of Observations of Occultations of Stars by the Moon, 1672–1908; being a revision of Newcomb's "Researches on the Motion of the Moon, Part 2". By Dr. H. Spencer Jones. Pp. 70. (London: H.M. Stationery Office.) 5s. net.

Proceedings of the Royal Society. Series A, Vol. 137, No. A833, September 1. Pp. 481–723. (London: Harrison and Sons, Ltd.) 12s.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1459 (T.3220): Interference on Characteristics of Aerofoil in Wind Tunnel of Rectangular Section. By H. Glauert. Pp. 7+1 plate. (London: H. M. Stationery Office.) 6d. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 71, No. 429, September. Pp. 405–540+xviii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

The National Institute of Poultry Husbandry, Harper Adams Agricultural College, Newport, Shropshire. Bulletin No. 7: Mixed Protein Rations for Laying Hens and Breeders (Single Comb White Leghorns). By Raymond T. Parkhurst. Pp. 20. Bulletin No. 8: The Production of Table Ducklings; Barley Meal and Sussex Ground Oats for Rearing and Fattening Table Ducklings. By Violet K. Tallent. Pp. 20. (Newport.)

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1932–33. Pp. 372. (Manchester.)

Character and Personality: an International Quarterly for Psychodiagnosis and Allied Studies. Edited by Robert Saudek. Vol. 1, No. 1, September. Pp. 87. (London: George Allen and Unwin, Ltd.) 2s.

The Journal of the Quekett Microscopical Club. Edited by W. S. Warton. Ser. 2, Vol. 16, No. 98, September. Pp. 215–260+plates 5–10. (London: Williams and Norgate, Ltd.) 5s. net.

Brochure containing Lists of Recent Additions to the Library, Cabinets and Collections of Instruments of the Quekett Microscopical Club. Pp. 10. (London: Quekett Microscopical Club.) 1s.

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 5: The Geology of the Roundstone District, County Galway. By L. R. Wager. Pp. 45–72+5 plates. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s. 6d.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1463 (T.3224): Acceleration of Aeroplanes in Vertical Air Currents, Part 1. By H. R. Fisher. Pp. 16+4 plates. 1s. net. No. 1456 (T.3198): Relation between Ground Contours, Atmospheric Turbulence, Wind Speed and Direction. By W. R. Morgans. Pp. 39+12 plates. 2s. 3d. net. No. 1464 (T.3216): Wind Tunnel Tests of Recommendations for Prevention of Wing Flutter. By B. Lockspeiser and C. Callen. Pp. 32+13 plates. 1s. 9d. net. No. 1469 (T.3234): Induced Flow through a Partially Choked Pipe. By H. Glauert, D. M. Hirst and A. S. Hartshorn. Pp. 15+4 plates. 1s. net. No. 1470 (T. 3249): Wind Tunnel Interference on Aerofoils. By H. Glauert. Pp. 11+4 plates. 9d. net. (London: H.M. Stationery Office.)

Transactions of the Leicester Literary and Philosophical Society, together with the Council's Report and the Reports of the Sections, 1931–32. Vol. 33. Pp. 51. (Leicester.)

OTHER COUNTRIES

Records of the Geological Survey of India. Vol. 66, Part 1. Pp. 179+24+2 plates. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5s.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 121: Contributions to a Knowledge of the White Flies (*Aleurodidæ*) of Egypt (I). By Prof. Dr. H. Priesner and Mahmoud Hosny. Pp. 8+6 plates. 2 P.T. Bulletin No. 122: Sand-sowing in Growing Cotton. By Gadallah Aboul Ela. Pp. 12+2 plates. 5 P.T. (Cairo: Government Press.)

Ministry of Public Works, Egypt: Physical Department. Helwan Observatory Bulletin No. 35: Installation of the Schuster-Smith Magnetometer, and the Helwan Standard of Horizontal Intensity. By P. A. Curry. Pp. 11+2 plates. (Cairo: Government Press.)

Smithsonian Miscellaneous Collections. Vol. 87, No. 11: Report on Archæological Research in the Foothills of the Pyrenees. By J. Townsend Russell. (Publication 3174.) Pp. 5+8 plates. (Washington, D.C.: Smithsonian Institution.)

Department of Science and Agriculture, Jamaica. Entomological Bulletin No. 6: Lecture delivered under the Auspices of the Citrus Producers' Association on the occasion of the Importation into Jamaica of a Parasite (*Eretmocerus serius*, Silv.) of the Citrus Black Fly (*Aleurocanthus Woglumi*, Ash.). By W. H. Edwards. Pp. ii+12. (Kingston, Jamaica: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 81, Art. 5: A New Trematode of the Genus Urotrema from Bats. By Joseph E. Alicata. (No. 2928.) Pp. 4. Vol. 81, Art. 8: The Fishes obtained by Lieut. H. C. Kellers of the United States Naval Eclipse Expedition of 1930, at Niuafoou Island, Tonga Group, in Oceania. By Henry W. Fowler. (No. 2931.) Pp. 9. Vol. 81, Art. 16: Notes on the Helminth Parasites of the Opossum (*Didelphis virginiana*) in Southeast Texas, with Descriptions of Four New Species. By Asa C. Chandler. (No. 2939.) Pp. 15. (Washington, D.C.: Government Printing Office.)

Canada: Department of Mines: Mines Branch. Gold in Canada. By A. H. A. Robinson. (No. 730.) Pp. vii+92. (Ottawa: F. A. Acland.) 20 cents.

Sveriges Geologiska Undersökning. Ser. Ba, Nr. 12: Kvartärgeologisk karta över Stockholmstraktens, Skala 1:50000. 5.00 kr. Stockholmstraktens Kvartärgeologi. Av Gerard de Geer. Beskrivning till kvartärgeologisk karta över Stockholmstraktens, Skala 1:50000. Bilaga med specialundersökningar; with English Explanations. Pp. 89. 3.00 kr. (Stockholm: P. A. Norstedt and Söner.)

Geological Survey of China. Soil Bulletin No. 4: Soil Survey of the Salachi Area, Suiyuan Province, China. By Robert L. Pendleton, L. C. Ch'ang, W. Chen and K. C. Hou. Pp. 42+8 plates. (Peiping.)

Bulletin of the American Museum of Natural History. Vol. 59, Art. 8: Fossil Sirenia of Florida and the Evolution of the Sirenia. By George Gaylord Simpson. Pp. 419–503. (New York City.)

Carnegie Institution of Washington. Publication No. 426: Gorillas in a Native Habitat. Report of the Joint Expedition of 1929–30 of Yale University and Carnegie Institution of Washington for Psychobiological Study of Mountain Gorillas (*Gorilla beringei*) in Parc National Albert, Belgian Congo, Africa. Pp. iv+66+22 plates. (Washington, D.C.: Carnegie Institution.)

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 14: April, May, June, 1932. By Ernest A. Hodgson. Pp. 227–244. (Ottawa: F. A. Acland.) 25 cents.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 4, No. 7–8, Juillet–Août. Pp. 285–376. (Prague: Regia Societas Bohemica Scientiarum.)

Journal of the Indian Institute of Science. Vol. 15B, Part 3: Transients in Negative Series Circuits. By L. C. Verman. Pp. 33–42. 1·4 rupees. Vol. 15B, Part 4: Telephony as Carrier and One Side Band. By S. P. Chakravarti. Pp. 43–48. 1 rupee. (Bangalore.)

Journal of the University of Bombay. Vol. 1, Part 1, July. Pp. 248. (Bombay and London: Longmans, Green and Co., Ltd.) 3 rupees.

Geological Survey of Uganda. Memoir No. 2: The Geology of South-West Ankole and adjacent Territories with Special Reference to the Tin Deposits. By A. D. Combe; with an Appendix on the Petrology, by Dr. A. W. Groves. Pp. xiv+236+19 plates. (Entebbe: Government Printer.) 35s.

Ceylon. Part 4: Education, Science and Art (G.). Administration Report of the Marine Biologist for the Year 1931. By Dr. Joseph Pearson. Pp. 11. (Colombo: Government Record Office.) 10 cents.

SATURDAY, NOVEMBER 5, 1932

CONTENTS

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Inland Water Survey

IT was a welcome and appropriate sequel to the leading article in NATURE of July 2 last, relating to "River Gauging and Flood Prevention", that a sectional meeting of the British Association at York should have been devoted to a discussion on the organisation required for the recording of water levels and river flow in the British Isles. The discussion did not arise out of, nor was it in any way consequential upon our article—it had, in fact, been arranged some time beforehand—but it served admirably to give point and emphasis to the contentions put forward in these columns on a matter which has not hitherto received the attention and consideration which it deserves.

The meeting was held under the chairmanship of Prof. L. S. Palmer and had before it an introductory memorandum prepared by Capt. W. N. McClean, through whose instrumentality mainly the discussion at York was arranged. Capt. McClean added some opening explanatory remarks in which he directed attention to the essential value and fundamental importance of reliable records of water measurements in questions relating to water supply, water power, navigation, irrigation, fisheries, drainage and pollution, flood prevention and other matters of national and civic concern. He stressed the necessity of providing an efficient organisation to make systematic observations on scientific lines. An inland water survey should cover rainfall, storage and flow. Rainfall is already to a very considerable extent adequately cared for by the British Rainfall Organization, which has an excellent system, though perhaps it is still open to improvement in certain details. But rainfall does not afford correct information as to storage and flow, and only when these are also as efficiently recorded, can estimates be made which will be of value in dealing with problems of drought and flood. Capt. McClean's conviction is that an inland water survey should be independent of conflicting interests, private or corporate; that it should be under a Water Survey Department of a Ministry, with the supervision of an expert Government inspector over large areas; and that local associations should represent the water interests and find the observers and recorders. Funds should be provided by the water interests by means of a levy.

In the ensuing discussion various suggestions were made as to the nature of the controlling authority and these were summarised at the

conclusion of the meeting by the chairman, as follows:—(1) An organisation on the lines recommended by the Water Power Resources Committee; (2) the Geological Survey; (3) the Ordnance Survey; (4) the Meteorological Office of the Air Ministry; (5) Catchment Boards, formed under the Land Drainage Act, in co-operation with the Ministry of Agriculture and Fisheries; (6) voluntary organisations, and (7) various combinations of (1) to (6).

As regards the first suggestion, it will be recalled that the Final (1921) Report of the Water Power Resources Committee, appointed in 1918, recommended the formation of a Controlling Water Commission, to be established by Act of Parliament, the primary function of which would be "to compile proper records of the water resources and present and future water requirements of the country and to collect information on these subjects through existing Departments and other agencies, as well as through their own hydrometric staff". It is perhaps superfluous to add that nothing has been done in this direction, nor, in view of prevailing financial conditions, is anything likely to be done in the way of establishing another Government department with scope for additional expenditure. Moreover, the situation has changed appreciably since the publication of the Water Power Resources Committee's Report.

Within the last two years, the Land Drainage Act, 1930, has created a series of Catchment Boards (at present forty-six in number) to act under the Ministry of Agriculture and Fisheries, with the special duty of dealing with all matters relating to the drainage of their respective areas. As we pointed out in our previous article, although not specifically laid down in the Act, it is obviously the implied duty of Catchment Boards to gauge and survey the run-off in the streams and rivers under their jurisdiction and to obtain a reliable record of rates of flow, ranging between maxima and minima, over long periods, which will enable adequate precautions to be taken for dealing with the incidence of floods and of drought. But while the responsibility for obtaining this information, as was urged by Capt. J. C. A. Roseveare, of the Ministry of Agriculture and Fisheries, in the discussion at York, clearly lies with the Catchment Boards, the question, at once, arises: Will all these separate and distinct bodies, with their varying organisations and staffs of unequal calibre, be likely to obtain and collate the data on uniformly satisfactory and rigidly scientific lines? We are afraid not. There must be some centralised authority of high technical standing to supervise and unify the methods and systems of measurement. Otherwise, the records will inevitably tend to be of differing values.

It will be noted that suggestions were put forward to bring the observations under the control of official technical departments, such as the Ordnance Survey, the Geological Survey and the Meteorological Office. We are of opinion that the duties of these bodies are already onerous enough for satisfactory performance, and that the additional functions proposed to be assigned to them are not sufficiently germane to their existing functions to justify the expansion of their establishments. We would prefer that a properly devised scheme should be worked out in conjunction with the Department of Scientific and Industrial Research, to which should be entrusted the inauguration and supervision of operations, under the local administration of the Catchment Boards, who would be called upon to provide the staffs and the funds for the purpose, the latter being apportioned from the rates which the Boards are statutorily authorised to levy. The proposal would not by any means exclude the assistance of voluntary workers, including university students and others, who, as in the case of rainfall gauging, might be attracted to the making of observations locally, as a scientific pursuit, or hobby. Nor would it interfere with the full exercise by the Catchment Boards of their powers and responsibilities in regard to drainage and flood protection.

The speakers in the discussion at York were unanimous in affirming their conviction of the necessity for taking steps forthwith to put an end to the anomalies and defects of the present position and, at the conclusion of the proceedings, a representative committee was formed "to inquire into the position of Inland Water Survey in the British Isles and the possible organisation and control of such a survey by central authority". This is a move forward in the right direction, and if a soundly devised and workable scheme is forthcoming as the result of the committee's efforts, it should carry weight with the Government. In a matter of such pressing national importance as flood prevention, it is in the highest degree necessary to have accurate and unimpeachable records of river flow, as it is no less imperative to have them for the successful prosecution of industrial and civic undertakings in regard to water supply and hydraulic development generally.

Leeuwenhoek, 1632–1723

Antony van Leeuwenhoek and his "Little Animals": being some Account of the Father of Protozoology and Bacteriology and his Multifarious Discoveries in these Disciplines. Collected, translated, and edited from his Printed Works, Unpublished Manuscripts, and Contemporary Records, by Clifford Dobell. Published on the 300th Anniversary of his Birth. Pp. vii + 435 + 32 plates. (London: John Bale, Sons and Danielsson, Ltd., 1932.) 31*s*. 6*d*. net.

OF all the great naturalists of the past, Leeuwenhoek occupies the unique and anomalous position of being the most frequently quoted and at the same time the least appreciated and understood. An estimate of his work which is commonly expressed and accepted, even by those who have devoted some attention to the history of biology, is that he was a superficial dabbler who had no conception of scientific methods, but who hurried from one topic to another without attempting to exhaust any one of them; and that if he made important discoveries it was easy to do so, since he was early in the field, and one of the first to exploit an important new means of investigation. He is in fact compared unfavourably with his great contemporaries Swammerdam and Malpighi, both of whom successfully completed solid pieces of research involving concentrated and prolonged attention to the points at issue.

Such a criticism, however, fails to take account of the distinguishing features of most of Leeuwenhoek's work. He was not dealing with large and complex objects out of which much could be made even in those days, but with blood corpuscles, bacteria, protozoa and other small organisms which it is amazing he should have seen at all, and not that he should have failed to make more of them. His point of view was essentially that of the microscopist even when investigating the larger animals. Impressive and spectacular results, such as Malpighi's development of the chick and Swammerdam's anatomy of the mayfly, were literally impossible, and the significance of his work, to quote Capt. Bunsby, lies in the application thereof.

Against the charge of lack of tenacity, Mr. Dobell's treatise is a sufficient answer, even if we had not in mind Leeuwenhoek's laborious and long-continued attack on the spermatozoa. Then again his method of publication, or rather the lack of it, has told heavily against him. His results were communicated in the form of letters, most of them addressed to the Royal Society, which have never until recently been published in full, and have only been partly translated. The result is that much of his work is still almost unknown. For example, Mr. Dobell directs attention to Leeuwenhoek's unrecognised anticipation of the modern malariologist as to the difference in posture between Anopheline and Culicine larvæ in water, and he has translated, and now publishes for the first time, Leeuwenhoek's observations on the viviparous nature of the vinegar worm made in 1676—a discovery attributed to Sherwood in 1746.

There are inevitably many other discoveries made by Leeuwenhoek which have yet to find their place in any history of biology. The appearance of the work under review therefore is more than welcome—it is an act of justice, and the only regret we feel in respect of it is that it covers but a fraction of Leeuwenhoek's stupendous labours. Our regret is heightened by the reflection that we do not see where the completion of the task is to come from. It demands an unusual combination of linguistic and other qualifications which Mr. Dobell alone seems to possess, and, moreover, he has advanced the standard of historical research beyond the reach of most workers. He exhibits indeed to a marked degree that passion for detail and meticulous accuracy which bulks so largely in the composition of the complete scholar. It makes him a severe and occasionally a merciless critic of the work of others, but it is a guarantee of the integrity and exhaustive nature of his own inquiries.

To most zoologists, Leeuwenhoek's work on the smallest organisms, namely, the bacteria and protozoa, by its implications perhaps the most important that he did, is nevertheless not the most interesting. His observations on the blood corpuscles and capillaries, spermatozoa, Mendelian inheritance, rotifers, ants, caudal heart of the eel, *Echinorhynchus*, cestodes, compound eye, plant lice, *Cyclops*, *Hydra* and sponges, to mention only a few that come to mind, should be dealt with in the same comprehensive way as have been the bacteria and protozoa by Mr. Dobell, and until that is done Leeuwenhoek's merits can be but imperfectly appreciated by the average biologist. To complete this undertaking, however, on the scale of Mr. Dobell's investigations, and no other should be entertained, would take almost a lifetime.

May we here express regret that the Royal Society allowed to pass unnoticed the tercentenary celebrations of Malpighi in 1928, and appears to be displaying the same indifference to Leeuwenhoek in 1932. Whilst the Society deserves the highest credit for the active support it gave to these observers during their lifetime—a proceeding, be it noted, which has brought considerable honour to the Society—present councils seem to have forgotten that Malpighi and Leeuwenhoek were two of the greatest fellows the Society has ever had.

Mr. Dobell's work includes an introductory epistle to the reader, written in a quaint and charming style, all that tireless and intensive research can reveal of Leeuwenhoek's life, translations and exhaustive analyses of those of his letters which deal with bacteria and protozoa, an admirable chapter on his instruments accompanied by a plate which shows at a glance the design and manipulation of his best microscopes, and a critical estimation of his place in protozoology and bacteriology. There are minor sections on Leeuwenhoek's name, language, dwelling, draughtsmen, portraits and seals. The bibliographical chapters give details of his first twenty-seven letters, an invaluable catalogue of his MSS. and published works, which have so far been the despair of the bibliographer, but need be so no longer, and a long and exhaustive list of references and sources. The get up of the book, with its white buckram binding, sprinkled edges and title in two colours doubtless in imitation of the collected works bound in vellum, is excellent, and the plates have been beautifully reproduced. Most readers will be glad to have the admirable reproductions of Verkolje's mezzotint and oil-painting of Leeuwenhoek, of which the latter will be new to most students, and is much more convincing than the mezzotint. The enlargement of Goeree's miniature portrait has been very skilfully carried out, even to the removal of the hand of the substantial angel from the top margin. We should not have selected for reproduction the picture of de Graaf inserted at p. 40, which is apparently a somewhat poor copy of the portrait dated 1666 published in the "De Virorum", which latter has the additional advantage of being signed by both artist and engraver.

Since Mr. Dobell appeals for criticism we submit the following points for his consideration. Is not the last line but four of the Latin dedication ambiguous and liable to misinterpretation? Its meaning will be obvious to the initiated, but a literal translation of it would be libellous. P. 318: The paper by Baker dated 1740 which "must have been published considerably later" was published in 1744. P. 332: The interesting and probable suggestion that Leeuwenhoek used dark-ground illumination receives some support from the fact that Hooke described a simple type of dark-ground illumination in 1678. P. 333: Boyle, Hooke, Grew and Malpighi all made use of sections as aids to anatomical study before Leeuwenhoek. P. 350: The portrait by A. Smith is a copper and not a steel engraving. P. 364: Stelluti's plate of the bee was originally issued in 1625. Attention was first directed to this important publication by Parsons, who possessed a copy of the print and described it in 1752 as being "the first microscopical engraving that ever was made". P. 379: The term Infusoria was invented by Major in 1667 and was applied to intravenous injections. P. 379: George Adams the elder was born in 1720. P. 392 (No. 1): A second edition was published at Delft in 1694 and included letters 32, 39 and 33 in that order. P. 392 (No. 5): There *is* an edition of 1691 with the same title and publisher, but with the mispagination corrected. P. 393 (No. 13): For Londen read London. P. 413: Malpighi's "Opera posthuma" was first published at London in 1697 and this edition should be quoted. P. 415: Needham 1749 was published in 1750. P. 425, last line but one: For wo read woe. These are all small matters—of major slips the work seems to be entirely free.

We warmly commend Mr. Dobell's monograph to that section of the public, happily becoming larger every day, which is interested in the history of science. We believe that in the fulness of time this work will be recognised as one of the classics of the critical and historical literature of biology.

The New Economics

This Age of Plenty—its Problems and their Solution. By C. Marshall Hattersley. Third edition. Pp. 410. (London: Sir Isaac Pitman and Sons, Ltd., 1932.) Paper, 3*s*. 6*d*. net; cloth, 6*s*. net.

HITHERTO economics may be said to have centred largely around production, but now the centre has shifted to distribution, where the problems seem to be rather more baffling and intractable. But the world crisis, as is usually the case, has stimulated a high level of thought and

discussion, for the whole world is stirred to its depths so that the standard of emotional and intellectual activity is much higher than during the humdrum days of smooth and uneventful prosperity. Therefore we can confidently expect that a way out will be found, though some may think a return to material prosperity a doubtful blessing if accompanied by a relapse into dullness: the majority will be quite willing to run the risk. At present the mind of the nation is undoubtedly stimulated, and certain fundamental leading ideas appear to be gradually evolving out of a vast mass of animated discussion and suggestion, and are forcing their way to the front, serving, let us hope, under heaven's blessing, as a starting point for practical effort in the right direction.

Doubtless a lot of practical experiment will have to be undertaken, and possibly even a lot of mistakes made. Side by side with a firm faith that we shall ultimately succeed there must be also a high courage that will boldly try out new ideas even with the risk of temporary failure and error. It is no doubt a trite platitude to say that a nation, like an individual, that never makes mistakes and is afraid of the risk, will never achieve anything; but it seems at this time necessary to remind ourselves of the fact. More and more it becomes evident that, in the realm of economics and politics more practical experiment is urgently needed, though this cannot be faced with thoughtless light-heartedness and the difficulties are great, especially in unbiased interpretation of results. Let us hope, nevertheless, that we shall soon have a real science of experimental economics—and if the 'new' economists have their way we shall—so that the old reproach against the social sciences generally, and economics in particular, will be wiped out in triumphant ascension to the rank of true science on terms of equality with chemistry and physics, in view, too, of its increasing strength of statistical and mathematical groundwork.

On the side of production, as already suggested, the main problems appear to have been solved—if anything rather too thoroughly, largely owing to the fact that production has been placed on a scientific and rational basis. The same cannot be said of distribution and most emphatically not in regard to our financial and monetary system. This had been roundly criticised, sometimes perhaps rather wildly, but for the most part the criticism has been just, and, in view of the deplorable results of muddle-headed monetary policy, extremely restrained and moderate. A large number of interesting suggestions has been made for monetary reform, but for the present we are only concerned with those relating to Consumer Credit and the proposals made by Major Douglas, Prof. Soddy and one or two others. These have been fully and admirably dealt with in the third edition of C. Marshall Hattersley's book entitled "This Age of Plenty".

The main difficulty to-day is to increase the community's purchasing power: for production tends more and more to outstrip consumption; and with increasing mechanical and other scientific aids, increased production is consistent with constantly reduced man-power employed in industry. A careful and fairly complete analysis of the whole position, and particularly of prices and costs, leads Mr. Hattersley to support Major Douglas's proposals for Consumer Credit, which practically amount to national dividends for all. One method is to sell goods at less than cost price, the vendor recovering the balance from the State. The ethical grounds on which national dividends for all can be justified are well argued. There are not only the precedents of Old Age Pensions, Unemployment Insurance and Poor Law Relief, but there is also the further important consideration that every member of the community is entitled to a share in the rich heritage from the past, the accumulated cultural, economic and social possessions of the State. Modern production depends very largely for its efficiency on this heritage, which is something much more than capital or accumulated material savings. Every important invention, for example, has its roots in the past, and the inventor is indebted for help to hundreds or thousands of predecessors. Every member of the community therefore is entitled to some share in the product of modern industry, even if he does no work. It is not pretended that he should be idle, and this difficulty, as also that of the disagreeable menial tasks of society, and many other difficulties are ably dealt with.

Prof. Soddy, in his book on "Wealth, Virtual Wealth, and Debt" apparently agrees in principle with the Consumer Credit idea and the need for greatly increasing the supply of money, but he severely criticises the proposals of Major Douglas. Mr. Hattersley, who devotes a considerable amount of space to Prof. Soddy's ideas, is of opinion that the Douglas plan could be put into operation as a preliminary measure and that the way would then be clear for Prof. Soddy's plan to be adopted.

The whole subject is of profound interest and importance and well merits unbiased scientific examination and test. The book is well written and makes easy reading, the more so as each section is provided at the end with a synopsis of the points discussed. Many data of the statistical and blue book type are given in several appendices and there is a good and complete index.

W. G. L. C.

Industrial Chemistry

Industrial Chemistry: a Manual for the Student and Manufacturer. Edited by Allen Rogers. Fifth edition. Vol. 1: *Inorganic.* Pp. xiv + 641 + xiv. Vol. 2: *Organic.* Pp. xii + 642 – 1517. (London: Macmillan and Co. Ltd., 1931.) 30*s*. net each volume.

THIS treatise on industrial chemistry was first published in 1912, and is now in its fifth edition, being divided into two volumes. Allen Rogers, the editor, has had the co-operation of nineteen experts in preparing the inorganic volume, and of twenty-two specialists for the organic part of the subject, the division being a usual one.

The book has been modernised by addition and deletion, and fresh points of view and new subjects added. Naturally such a work can only act as a first and general introduction to each and any particular section of the chemical industry, and any one requiring to go more deeply into detail will have to study other treatises devoted to one subject only, for no one man can any longer pretend to have a knowledge of the whole field of chemical industry. Hence it serves a most useful purpose, all the more so when the summary is crisp and readable and not overburdened with manufacturing details. We have examined the book particularly from this point of view, and have found it more than fulfils our anticipation that it would provide just the right amount of information; indeed we already have the feeling that it may lie permanently on our desk.

Chemical industry has advanced probably at a greater rate than any other during the last decade. Not only has there been a very great reduction in the cost of making nearly all the standard chemicals, but also numerous substances which were formerly but chemical curiosities are now made and distributed by the car load, which is the American unit of quantity. Production and substances cost as many pence a pound as they formerly cost shillings, or even sovereigns. There is progress to chronicle most of all in the organic fields; new solvents for cellulose compounds, new resins and substances obtained by polymerisation have made rapid strides and it is safe to forecast that further advances will be made in this direction within the present decade. Most of the organic chemical industry in the past has been built upon tar as a raw material, and the layman has been made aware time and again of the bright-hued dyes, the potent drugs and the seductive perfumes wrought from this dark and evil-looking material. Whilst tar itself now plays a part in the new industry of making dustless roads, the organic chemist has developed two new raw materials for his manufactures. These are the hydrocarbons, liquid and gaseous, from crude oil, and alcohol derived by fermentation of molasses or other saccharine material. Very large quantities of both these raw materials are available, far exceeding that of tar if necessary, and it is expected that in time a very large industry will be built up in the products from each of them.

The invasion of the textile industry by the chemist is also only in its infancy, and viscose and acetate silk and cellophane are but the first of future materials derived from cellulose.

The industrial chemist has the task of making new products on the grand scale, of finding applications for them, and of cheapening the cost of production, handling and transport of materials of all kinds. Amazing is the rate at which progress is made when opportunity, including ample funds, allows experience to be gained on the large scale. The oil industry has taught us how to handle gases and liquids in very large quantities; the synthetic ammonia industry has introduced high-pressure technique; rayon has given the knowledge how to make and spin synthetic fibres; first sulphuric acid and later a whole range of organic industries have developed the potentialities of catalytic reactions, of which at present we have only barely a glimpse.

An interesting chapter from the point of view of developments is that headed "Elements and Compounds", in which brief reference is made to a number of substances listed in alphabetical order. Against some of the elements is the remark "this has at present no commercial value", though in some cases the remark is already out of date. Thallium, for example, first discovered by Crookes, has now definite industrial uses, and its price has been brought down below £3 a pound. Under tungsten we read that the requirements have

increased owing to its use in automobiles and aeroplanes; tantalum has become an important factor in the modern radio set. A comparison with a similar list in the 1912 edition of the book would show the rate at which the chemist and the physicist are turning to practical use the rarest of the elements. Stone age, iron age, bronze age mark stages in the history of the world: the age when all the elements are made serviceable to man is approaching.

The American origin of the work is indicated by the fact that under the influence of the 18th Amendment the chapter on brewing was eliminated from the last edition. It is now restored, but the subject is presented strictly from a technical point of view and in no sense as an aid to home fabrication. So we read how China made its beer 3000 years before the Christian era, and how to brew temperance beer with 7–8 per cent extract and malt tonics.

Any criticism in detail of such a wide treatise is impossible—it perhaps has faults of omission and inaccuracy, but we are more concerned with the vast amount of information contained in it and the manner of its presentation in readable form, for which we accord generous praise.

E. F. A.

Short Reviews

Geology of Petroleum. By Prof. W. H. Emmons. Second edition. Pp. xi + 736. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 30*s.* net.

A DECADE of petroleum geology separates the two editions of Emmons's work, and in that time much has happened in this realm of activity. Oilfields undreamt of then have been developed in parts of the world, including America, where not even the wildest imagination had pictured them. Pools of great magnitude were located, records in depth of wells and yield of oil established, and all this time geological knowledge was being enriched. The author had no alternative but to re-write and, fortunately, to re-illustrate his book, although the grounds for criticism of the first edition have by no means been removed in the new work. It shows a sad lack of sense of proportion to accord to the descriptions of the world's oilfields four-fifths in favour of the two Americas and only one-fifth for the rest of the world. No one disputes the economic pre-eminence of the oilfields of the New World, but this should not weigh in a book of this kind purporting to establish and describe geological principles as affecting petroleum from the universal store of information now available.

Study of the smallest field in a corner of Asia may be, and frequently has been in the past, of far greater academic import than the reams of subsurface data published in connexion with a few of the giant oil-pools of the United States. Here the treatment of such fields as Germany, with its vastly informative salt bodies, Rumania, Palestine, Persia, Iraq and India, including Assam and Burma, the last six in less than twenty pages, including copious diagrams, to say nothing of the mere mention of Miri in less than a dozen lines, is futile. It does not help matters to give references alone; in a general text such as this, the international student of the subject often wants information of a field or oil district such as he would expect to find in "Emmons" comparable with this author's thorough accounts of the United States fields; that is precisely what he will not find, which is a great pity, since the book generally is an improvement on the first and, following the success of the latter, will naturally command wide attention.

The History and Work of Harvard Observatory, 1836 to 1927. By Solon I. Bailey. (Harvard Observatory Monographs, No. 4.) Pp. xiii + 301 + 23 plates. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 17*s.* 6*d.* net.

THE study of astronomy was held in considerable esteem at Harvard College from the time of its foundation in 1636. Solar eclipse and transit of Venus expeditions were undertaken even in those early days, and various miscellaneous astronomical work accomplished. It was not, however, until 1839 that the Observatory was founded, with a very meagre equipment, to be supplemented eight years later by the 'Great Refractor' (15-inch) with which so much good work was done under the Bonds. Since then the Observatory has developed rapidly (especially under the directorship of Prof. E. C. Pickering) to its present position of international fame.

The story of its development and achievements is well told by the late Prof. Bailey, whose forty-four years of service rendered him specially fitted to act as historian. The first part of his book deals with the origin and history of the Observatory, describing its progress and activities up to 1927. The second part (occupying about half the book) gives an account of the astronomical researches and discoveries made at the Observatory. These are so numerous and varied that the result rather resembles a general history of astronomy during the period considered; it is at least striking evidence of the prominent part played by Harvard in the development of modern astronomy.

The descriptions are necessarily condensed (with the result that the work of outside observers does not always appear to occupy its proper place in relation to the problems described); but nothing of importance is omitted, and the material is con-

veniently classified into chapters dealing with kindred subjects. The final section of the book gives good biographies of the directors, prominent members of the staff, and benefactors. The whole is of great interest to astronomers, both amateur and professional, and especially to students of the history of astronomy.

Das Pollersche Verfahren zum Abformen an Lebenden und Toten sowie an Gegenständen: Anleitung für Mediziner, Anthropologen, Kriminalisten, Museumspräparatoren, Prähistoriker, Künstler, Handfertigkeitslehrer, Amateure. Von Dr. Alphons Poller. Herausgegeben von E. B. Poller und E. Fetscher. Pp. xii + 216. (Berlin und Wien: Urban und Schwarzenberg, 1931.) 12 gold marks.

This book, illustrated with 129 text figures, is a very thorough guide to the technique of the improved methods of casting living subjects and dissected specimens, which were devised by the late Dr. Alphons Poller. By the use of the elastic materials known under the trade names 'Negocoll' and 'Dentocoll' it is possible to make very exact moulds of complicated objects such as human brains or the head and hands of living men with an ease and precision which it is difficult or even impossible to attain with plaster of Paris. From these moulds casts are made in 'Hominit' and 'Celerit'. Many scientific workers in the biological and anthropological fields are already familiar with these devices and appreciate the value of the boon Poller's methods have conferred upon them. In fact, it is only the high price of the new materials which has hitherto stood in the way of the wider adoption of these eminently useful devices for making records in the form of durable casts

This book gives a very detailed account of the technical processes involved in casting and will be eminently useful to all, whether they are anatomists, palæontologists, zoologists, anthropologists, medical men, criminologists, museum preparators or artists, who want to preserve exact records of the form and surface details of any object.

Elements of Engineering Geology. By Prof. H. Ries and Dr. Thomas L. Watson. Second edition. Pp. vii + 411. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 18*s*. 6*d*. net.

Probably the best departure from the first edition of Ries and Watson's well-known book is the inclusion of a chapter on the geology of reservoir and dam sites which, in view of the big water-impounding schemes put forward in various countries in the last few years, is quite useful. On the other hand, the new chapter on historical geology is superfluous; one cannot adequately condense even an outline of the subject into less than fifty pages, as here, and in any event the modern civil engineer receives instruction in stratigraphical geology as part of his training; if he requires information regarding the geological column of his country, he at least knows where to get it, and one cannot imagine the most elementary student of the subject ignoring the standard text-books in favour of this make-weight chapter. Neither, as a minor point, does it look well in a book published at the price of this, to include a new section the page numbers of which are 313a to 313t inclusive. For the rest, there is little to comment upon; the book is a typical Wiley production, full of the usual geological diagrams and illustrations well executed and printed.

France: a Regional and Economic Geography. By H. Ormsby. Pp. xiv + 515. (London: Methuen and Co., Ltd., 1931.) 21*s*. net.

During recent years a great many detailed monographs on different parts of France have been published by French geographers as well as a number of works on various aspects of the geography of France, but English students have had no comprehensive volume on the country. Mrs. Ormsby has supplied this need most successfully. Her treatment is mainly regional and written from the point of view of the geographer with economic interests, but there are also general chapters on climate, agriculture and communications.

The volume is packed with information. Every town of any size has its site and activities analysed. But the details are well arranged and the point of view so well maintained that the book reads easily and holds the attention. Numerous sketch maps are of great assistance and there are references in every chapter to the relevant sheets of French maps. There are also copious bibliographies the value of which would be enhanced if the dates of all the books were given. This volume should make a wide appeal to students of geography or indeed to any reader who wishes to understand France and French activities.

Systematic Botany of the Flowering Families in North China. By Prof. J. C. Liu. Pp. xxiv + 213. (Peiping: The French Bookstore, 1931.) 5 Mexican dollars.

Prof. Liu is to be complimented on being a pioneer in the production of a little textbook specially adapted for elementary students in North China, where greatly increased interest in the subject has been a feature in recent years. Engler's system is adopted—each family being illustrated by a drawing of a typical Chinese species which includes a floral diagram as well as dissections in every case. The descriptive part, which occupies forty pages, is lucid, terms being profusely illustrated by excellent line drawings, though the definition of a genus on p. 20 is misleading owing to an unfortunate simile. The keys to the genera are based on very simple characters, but in those families such as Gentianaceæ where flower colour has been used, they are likely to break down in some cases.

C. V. B. M.

Consumption and the Trade Cycle

AT the recent meeting of the British Association at York, Prof. Lionel Robbins, professor of economics in the University of London, in a paper read before Section F (Economic Science and Statistics) on "Consumption and the Trade Cycle", made a critical examination of the 'Social Credit' proposals associated with the name of Major C. H. Douglas. The following is a short summary of this part of his argument.

Major Douglas bases the diagnosis on which his constructive proposals depend on a survey of factory costing. Consider any article of factory manufacture, he says: a nut and bolt, for example. Part of its cost consists of wages, salaries, etc.; but part consists of raw material charges, factory upkeep and similar 'overheads'. The sums distributed as *income*, therefore, are not sufficient to purchase current output. What is true of one factory is true of all. It follows, therefore, that throughout the entire economic system, there is a continuous deficiency of income to purchase the product; a deficiency which, if not made good by the continuous issue of paper money, must necessarily lead to chronic bankruptcy and confusion.

Now it is perfectly true, as Major Douglas urges, that the sums distributed as ultimate incomes—wages, salaries, rents, etc.—are insufficient to purchase the gross product of industry. *But so far from this being a cause of industrial crisis, it is in fact an essential condition of the smooth functioning of the economic system.*

This can easily be demonstrated if a capitalistic system which is in stationary equilibrium (that is, a system in which no saving is taking place) be examined with the view of discovering the conditions of the persistence of equilibrium. It should be clear that, of the total volume of payments being made at any one moment, only a comparatively small proportion is being made for the final product. The remainder goes to facilitate the movement of goods between the different earlier stages of production. That is to say, at the same time as money is being spent on bread by the wage-earner—the ultimate consumer—the baker is spending money on flour to replace the bread, the miller is spending money on wheat to replace the flour, and so on and so forth.

In order that such a system should continue in equilibrium it is necessary that these payments should be made; yet they do not go to the recipients of ultimate income. They are costs but they are not *net* income. In any computation of the *net* value produced during the unit period, such as that made in the British census of production, they will be set off one against the other. At the end, when they are thus offset, we get the value of the goods available for consumption; and for equilibrium to be preserved, it is necessary that the incomes of the factors of production should correspond only to this. In order that the same structure of production may persist from period to period, those payments in the gross income (to use the classical term) which cancel out *must* be made. It is undesirable, therefore, that a state of affairs other than that which Major Douglas describes should actually come to exist.

This conclusion becomes even more forcible if it be supposed that what Major Douglas thinks ought to happen has actually occurred. Suppose that, the quantity of money remaining the same, ultimate incomes were to be raised so as to equal the value of the gross product. What would this imply? Simply that the whole fund of free capital (amortisation quotas and working capital) had been turned into ultimate income. What would happen? Prices of ultimate commodities would probably rise; but prices of intermediate products, raw materials and fixed plant, would collapse. There would be no free capital to buy them with; there would occur all the symptoms of extreme crisis. Of course, such a state of affairs is not likely to occur. But, if wages are above the equilibrium point, it is possible for something disquietingly like it to begin to make its appearance. The illustration should at least make clear the fundamental point overlooked by Major Douglas: that once there exists what may be called *many-stage* production, it is undesirable that the money income in a given period should be equal to the value of the gross product of that period. Only in a system of hand-to-mouth, or single stage, production is it compatible with the requirements of equilibrium that the net income and the gross income should be identical.

Thus in the case most favourable to Major Douglas—the completely stationary state—his argument breaks down completely. If real accumulation is to take place—that is, if the system is to be progressive—then the refutation applies *a fortiori*. For, in such circumstances, not only must the gross income exceed the amount spent on consumption goods available by the difference between net income and gross income; it must also contain a quantity equivalent to the amount of net saving. If accumulation is to take place, there must be abstention from using all the productive power available to produce current real income at a constant rate. This involves spending some of the current money income on goods which only give rise to real income in the future.

In subsequent sections of his paper, Prof. Robbins argued that not only is there no reason to attribute industrial depression to a deficiency of consumption, but also that there is, on the contrary, considerable reason to believe that the coming of depression is due to the fact that consumption has become too high for capital extensions already embarked upon to be profitably carried through. Recent investigations, he argued, seem to make it more and more probable that booms are due to forced saving brought about by inflation of credits; and that the collapse of the

boom is due to the exhaustion of this process. It is truer to say that the depression comes because consumption is too urgent than because it is not urgent enough. We do not "starve in the midst of plenty" because we do not demand enough; we starve because, having forced the tree of prosperity, we seek to pluck its fruits before they are ripe.

It may be added that a more elaborate critique of proposals substantially similar to those of Major Douglas will be found in "The Paradox of Saving" by F. A. von Hayek in *Economica* of May, 1931.

Canadian Polar Year Expedition, 1932–33

CANADA'S part in the International Polar Year is to establish a chain of stations not more than 1400 km. apart, connecting Greenland with the United States station at Fairbanks, Alaska, and to provide special magnetic equipment at Meanook, the nearest permanent magnetic observatory to the north magnetic pole. For this purpose three expeditions have been sent out, the first to Cape Hope's Advance in Hudson Straits, 1000 km. from the nearest station in Greenland; Chesterfield Inlet on the west coast of Hudson's Bay, 1200 km. away; and finally Copper Mine on the Coronation Gulf, 1300 km. to the west, and a little more than 1500 km. from Fairbanks, Alaska. The accompanying map (Fig. 1) shows the position of these stations, as well as the regular meteorological stations in northern Canada. It may also be mentioned here that at these stations there are well-equipped wireless stations, so that communication can always be obtained with the outside world.

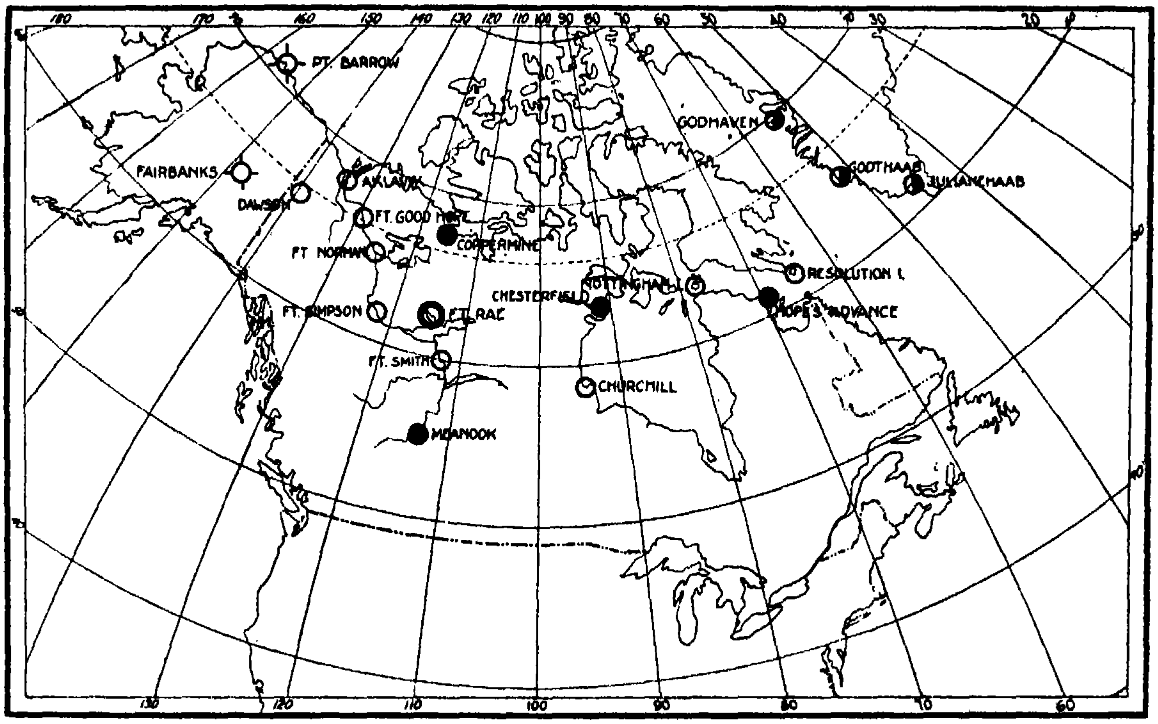

FIG. 1.—International Polar Year stations in North America and Greenland. ○, Canadian telegraph stations; ●, Canadian Polar Year stations specially equipped and manned; ◎, British expeditions; -○-, United States stations specially equipped and manned; ◐, Danish stations.

At *Cape Hope's Advance*, lat. 61° 5′ N., long. 69° 33′ W., complete surface meteorological and upper air observations, with twice-daily pilot balloon ascents, will be continued throughout the year. The auroral programme will consist of visual observations at specified hours, and as opportunity occurs photographs will be taken. The station is in charge of Mr. J. E. Lilly of Acadia University, assisted by the radio operators at the station. Cape Hope's Advance is situated on a fairly high promontory extending out into Hudson Straits, and at times very high wind velocities are obtained, the most notable being above one hundred and thirty miles an hour for one hour, and above one hundred miles an hour for several hours continuously. The temperature averages about fifteen below zero in January, while in the middle of summer it has exceeded 70°. Rainy days are frequent in June and August, frequently accompanied by fog with snow in any month of the year.

Chesterfield Inlet.—The principal Canadian station is at Chesterfield Inlet, lat. 63° 45′ N., long. 91° 50′ W., about four hundred and fifty miles from the north magnetic pole, this being the

nearest magnetic station to the pole that will be established in this international undertaking. The party is in charge of Mr. F. T. Davies of McGill University, who has had extensive experience in magnetic work on the Byrd expedition in the antarctic. He will be ably assisted by Prof. B. W. Currie of the University of Saskatchewan, Mr. Stuart McVeigh of Queen's University, and Mr. John Rea as assistant observer.

A complete set of Lacour self-recording magnetic instruments comprising nine variometers and three recorders will be installed, together with a Smith portable magnetometer, an earth inductor, and a Carnegie declinometer with absolute measurements. Advantage will also be taken of this to measure earth currents with a very complete earth current equipment. The auroral programme provides for two stations about 30 km. apart connected by radio, to measure the height of the aurora, and a McLennan night spectrograph to obtain photographs of the visible and infra-red portions of the spectrum. A complete log will be maintained of auroral phenomena, and its approximate intensity measurement with a pocket spectroscope.

As opportunity occurs, the atmospheric potential gradient will be measured by means of ionium collectors and the Patterson electrometer.

The meteorological equipment provides for full surface meteorological observations, pilot balloon ascents twice daily, kite flights as weather permits, and, on the international days, visual signalling meteorograph ascents. Continuous record of the difference in temperature between the top of the radio mast forty-five metres above the surface and the surface will be made with special thermocouples. At the same time an electrical resistance recording thermograph will give the temperature of the air at the four-foot level, and a Robitzch bimetallic actinograph and a sunshine recorder will be utilised for radiation measurements. A rangefinder has been included in the outfit to obtain the height of the cloud as frequently as possible, and the cloud observations will be made according to the programme of the International Cloud Commission. The radio operators at Chesterfield Inlet are entering very enthusiastically into the work also, and are lending very valuable assistance to the party. July is the warmest month at Chesterfield, with an average temperature of about 48°, while the coldest months are January and February, when the temperature goes to an average of 26° or 27° below, the lowest recorded being 55° below zero.

At Chesterfield Inlet there is a Roman Catholic mission which has a very fine hospital attached, a radio station, Hudson's Bay Mounted Police, and at times a doctor is stationed at the Inlet.

Copper Mine.—The third station in this chain is Copper Mine, lat. 67° 42′ N., long. 115° 30′ W., and will be in charge of Mr. R. C. Jacobsen of the University of Toronto, assisted by Mr. D. R. Kinnear and A. V. Potruff, radio operators. It will be the most important meteorological station in the system, and situated as it is on the Arctic Ocean about midway between the Atlantic and Pacific, it gives an exceptionally good opportunity to observe the influx of polar air from the arctic regions. At this station the same meteorological programme will be carried out as at Chesterfield, but in addition the Moltchanoff radio meteorographs will be used on international days, and besides recording the temperature at the top of the radio mast and at the four-foot level, it is hoped to make a special study of the cooling effect of the long winter nights and the temperature inversions.

The auroral programme will be the same practically as at Cape Hope's Advance. Visual observations will be made at definite hours and photographs taken as opportunity occurs. The meteorological station at Copper Mine has been in existence for about two years; during this time, average temperature in January is about 30° below zero, and on six occasions it fell below 40° below zero. The snowfall at Copper Mine is apparently very light, only two or three inches being recorded up to the end of January, while light rainfall occurs in April, and fairly heavy rain in July and August. This station is at the mouth of the Copper Mine River on Coronation Gulf, and is slightly north of Great Bear Lake.

Fort Rae.—Fort Rae is north of Great Slave Lake. It was the only continental station in Canada operated during the First International Polar Year, and is again occupied by the British. It is about three hundred miles due south of Copper Mine, and forms with the Canadian stations a most valuable link in the network of stations across the arctic this year. Through Fort Rae the Canadian stations are also connected with the permanent magnetic observatory at Meanock, lat. 54° 37′ N., long. 113° 21′ W., where a complete set of Lacour recording instruments have been installed. This magnetic station is the nearest permanent magnetic station to the north magnetic pole, and will be in charge of Mr. Vestine of the University of Alberta, with Mr. H. E. Cook as the magnetic observer. In addition to the magnetic work, auroral and meteorological observations will be taken as opportunity occurs.

All the Canadian stations in the arctic shown in Fig. 1 will take special meteorological and visual auroral observations. They have been furnished with a Lacour pocket spectroscope, in order that the intensity of the aurora may be estimated approximately.

It is a very great pleasure to acknowledge the loan of special equipment for this purpose from the United States Weather Bureau, the Carnegie Institution of Washington, the University of Toronto, McGill University, the Topographical Survey of Canada, the Dominion Observatory, the University of Saskatchewan, and the Department of National Defence.

The Canadian stations are among the pivotal stations envisaged in the programme of the International Polar Year Commission. The observations obtained during the present twelve months in meteorology and terrestrial magnetism at these isolated outposts in northern Canada promise to supply information long desired both by Canadian scientific services and by many investigators in geophysics.

J. PATTERSON.

Obituary

PROF. J. C. FIELDS, F.R.S.

IN the death of Prof. John Charles Fields on August 9 the University of Toronto lost one of its most renowned members and probaby its most gifted mathematician. Prof. Fields was born on May 14 at Hamilton, Ontario, in the year 1863. When quite young he displayed unusual skill in mathematics and in his university course at Toronto his brilliancy attracted much attention. Though his doctorate was taken at Johns Hopkins University, Baltimore, it was to Germany that he, like many another student from the American continent in the early days, turned for stimulus to mathematical research. There it was that he found his chief inspiration for his subject. He studied at Paris for a time but it was at Göttingen and Berlin, where he came under the influence of such leaders as Wierstrass, Klein, Fuchs and Schwartz, that his imagination was fired and the foundations laid for the creative side of his life's work.

In 1906, Fields published his famous treatise on "Theory of the Algebraic Functions of a Complex Variable", a work which at once received world-wide acclaim and won for its author immediate recognition as a mathematician of the first rank. In his conversations with me he often spoke with pride and with deep affection of the friendly part played by the late Mittag-Leffler, the renowned Swedish mathematician, in the negotiations that led up to the publication of this work.

Prof. Fields was called to the University of Toronto in the opening year of the present century. Since that time his researches and those of workers associated with him have been among the outstanding contributions to knowledge made by that institution.

In all his academic relations Fields strenuously advocated and promoted in every way open to him the claims of research. Soon after his appointment to Toronto he openly expressed the view that students desiring to specialise in mathematics came to universities in America handicapped by defective mathematical training in the secondary schools. Another handicap to which he considered the students of a generation ago were subjected both in Canadian universities and in American universities generally was that involved in the use of defective mathematical texts, more particularly of texts on the calculus. It was his considered opinion that one would not be far wrong in attributing the almost complete sterility of the mathematicians of the last generation in America to inadequate and ineffective teaching of the calculus. But all this was gradually changed. Through the efforts of Fields and of those other leaders holding similar opinions, new life was breathed into the teaching of mathematics in Canada and the United States, with the result that an ever-increasing stream of research achievement is becoming so great as to tax severely the facilities available for publication.

During the period of the War and for some time afterwards Prof. Fields was president of the Royal Canadian Institute of Toronto. Throughout his term of office he never ceased to advocate scientific research as the ideal of the Institute and to emphasise the opportunity its organisation afforded for the advancement of scientific thought. He initiated a movement in the direction of having research professorships attached to this institute similar to those now administered by the Royal Society, the Royal Institution and the Franklin Institute. From the way in which he laid his plans for the success of this project and from the manner in which he was quietly working them out I believe that had he lived but a few years longer he would have achieved his aim.

Prof. Fields was president of the International Mathematical Congress held in Toronto in 1924. It was a very successful meeting and it was largely through the financial aid personally secured by him that it and the meeting of the British Association for the Advancement of Science held at the same time were made possible. The fact that the Press of the University of Toronto was able to handle such a difficult typographical task as that involved in the printing of the "Proceedings of the International Mathematical Congress" was somewhat of a surprise to foreign mathematicians. It was only made possible, however, through the close co-operation that was maintained between Mr. R. J. Hamilton, director of the Press, and his staff on one hand and Prof. Fields with his associate editors on the other.

What I consider to be Fields's greatest achievement in advancing the cause of research in Toronto was the institution of the special annual finance grant that is made by the Legislature of the Province to the University of Toronto and ear-marked for research. The first of these grants, which amounted to more than 75,000 dollars, was made on the recommendation to the Government of Ontario of the Hon. Dr. H. A. Cody, then Minister of Education and now president of the University. I do not think I am revealing any secret in stating that this grant was secured very largely as a result of the most earnest solicitation by Prof. Fields.

One of Prof. Fields's last activities was the establishment of a fund with which to provide two or more gold medals, to be awarded by a Committee of the International Mathematical Congress at stated intervals for outstanding achievements in mathematical research. The initial sources of the fund were the cash balances remaining in the hands of the organisation committees of the 1924 Toronto meetings of the British Association and the International Mathematical Congress. His great interest in this fund

is shown by the fact that according to the provisions of his will the residue of his estate after certain annuities are paid will pass to the medal fund, which it gave him such pleasure and satisfaction to inaugurate.

Of late years Prof. Fields's life was more strenuous than the state of his health warranted. He frequently related with evident pleasure how he had just caught a tram, or train, and he often travelled by aeroplane in order to economise his time. Some twenty years ago an attack of rheumatic fever left him with health impaired, and in 1924, through carrying his luggage to the station on one of the numerous journeys made in organising the 1924 meetings, he overstrained his heart. In spite of this disability the last eight years of his life were crowded with activities. Two years ago he suffered a slight cerebral hæmorrhage and in May of this year he had a violent heart attack. He recovered sufficiently to sit up at times in a reclining chair from which he dictated letters at intervals to some of his intimate friends.

Prof. Fields was the recipient of numerous honours, but the one he valued most was his fellowship in the Royal Society of London. Quite recently the Italian Government expressed a desire to confer upon him an honour of rare distinction but this he was compelled to decline through the existence of self-denying legislation enacted in Canada at the close of the War. I should like to mention one outstanding mental gift possessed by him. It was his remarkable memory. It was my privilege to be present at a lecture given by him some years ago on "The Evaluation of π". To my astonishment he went to the blackboard in the course of the lecture and without hesitation wrote out the value of π correct to 200 decimal places.

Prof. Fields's life was spent in the cause of research. He was devoted to his friends, and I never knew anyone more pure in heart and thought or more generous in his judgments of others. With the words of one of his admirers I agree: "He has, I am sure, left behind him sweet memories with people the world over, and lucky, I think, are those who passed his way." I was fortunate in being one of that happy band.

J. C. McLENNAN.

MRS. G. P. BIDDER

THE life of Mrs. Bidder, who died on September 25 at seventy years of age, was full of beneficient activities—scientific, social and domestic. I am competent to touch only upon the earlier scientific period before her marriage when, as Marion Greenwood, she was well known to many scientific colleagues. She went to Girton from Bradford Girls' Grammar School with an entrance scholarship in 1879, when she was seventeen years old. She obtained a first class in both parts of the Natural Sciences Tripos for 1882 and 1883 and was at once appointed demonstrator in physiology to the science students of Newnham. In those days there were no lecturers in science at that college. In 1888 she was awarded by Girton College the Gamble prize for a dissertation.

In 1890 she was appointed the head of the Balfour Laboratory in Downing Place—a queer, ugly block of a building, once a chapel. How it came by so surprising a change I never heard. Some contraction in the spiritual life of Cambridge must have thrown it, a spiritual derelict, on to the market. At any rate it became the laboratory for women science students and, as Cambridge was still stirred by the genius and the tragic death of Francis Maitland the most brilliant of the Balfour brothers, it bore his name. There, until her marriage to Mr. George Bidder in 1899, Marion Greenwood was responsible for the teaching of the women science students, and herself taught.

Her research work, however, was carried out in Foster's laboratory, where physiologists and biochemists, still undivorced, habited adjacent rooms to their mutual comfort and benefit. The rooms, in order, down the little dark passage, were the homes of Sheridan, Lea, Walter Gaskell, Marion Greenwood, and beyond and through her room, in a cupboard of a place, Langley. Miss Greenwood was in a small passage room, and I shared the one bench with her. No modern Ph.D. aspirant could or would compress his or her activities into the space we were contented with in those days.

At that time women were rare in scientific laboratories and their presence by no means generally acceptable—indeed, that is too mild a phrase. Those whose memories go back so far will recollect how unacceptability not infrequently flamed into hostility. The woman student was rather expected to be eccentric in dress and manner; she was still unplaced, so far as the male in possession was concerned. Miss Greenwood, it so happened, was not only a woman of quite unusual intellectual distinction but she had also great personal charm and a great gift of comradeship. Science by no means absorbed all her interest which covered a wide knowledge of literature. She worshipped Meredith, and was a lover of Jane Austen and Peacock.

She took her share, and it was a large one, in the government of Newnham and Girton, but I am inclined to think that the best she did for women was just being her gracious and kindly self in those early days of hostility, touched as it was sometimes by a spice of active persecution.

Miss Greenwood made solid contributions to science. Her first scientific paper was on the gastric glands. The amazing story of the secretory granules, which revealed so much of the inner working of the living cell, was then being deciphered by Langley. Miss Greenwood was a histologist, and it was natural for her to join in that quest. Her paper of 1890 on the action of nicotin upon certain invertebrates also reflected

Langley's interests, but she soon struck out her own line, the physiology of the protozoa. Her papers on that subject are few but well worth reading now for she was above all an accurate observer.

Two stand out, that on the rôle of acid in protozoan digestion and that on the resting nucleus of protozoa. In the former, published jointly with Miss Saunders, an observation made at the Institut Pasteur by le Dantec was followed up and extended. He had found acid present in the food vacuoles. Vacuolar digestion the authors found always to be preceded by the secretion of acid and the acidity decreased to neutrality as digestion proceeded. The paper is in fact a noteworthy treatise on protozoan digestion (*J. Physiol.* 5, 1884).

The paper which interested me most at the time and which I still find colouring my views was on structural changes in the nucleus of protozoa. Not only can gross structure be changed but also the distribution and quantity of iron be altered by putting a 'metabolic strain' on the organism through diet or partial starvation from oxygen (*J. Physiol.* 20, 1896). Her active research career ended when she married.

W.B.H.

WE regret to announce the following deaths:

Dr. William Garnett, secretary and educational adviser to the London Technical Education Board, 1893–1904, educational adviser to the London County Council, 1904–15, and formerly principal and professor of mathematics in the Durham College of Science, Newcastle-upon-Tyne, on November 1, aged eighty-one years.

Prof. Thomas Gray, professor of technical chemistry at the Royal Technical College, Glasgow, a well-known authority on fuels, on September 26, aged sixty-three years.

Sir Bernard Mallet, K.C.B., Registrar-General from 1909 until 1920, president since 1929 of the Eugenics Society and a past president of the Royal Statistical Society, on October 28, aged seventy-three years.

News and Views

Nobel Prize for Physiology and Medicine for 1932

WE note with pleasure the honour conferred on British science by the award of the Nobel Prize for 1932 for physiology and medicine to two of our leading investigators of the physiology of the nervous system, namely, Sir Charles Sherrington, past-president of the Royal Society and Waynflete professor of physiology in the University of Oxford, and Prof. E. D. Adrian, Foulerton research professor of the Royal Society and lecturer in physiology in the University of Cambridge. In recent years it has generally been the practice to divide the prize into two parts and give them to two workers in a selected branch of medical science, but it is a rare fortune for both to fall to the lot of a single country. The chief contribution to our knowledge of the functions of the central nervous system has come to us through the researches of Sir Charles Sherrington, who by his great skill in experiment has brought the immense complexities of this subject within the range of objective analysis, revealing fundamental plan and orderly sequence in the numerous reflex actions by which the central nervous system controls the activities of the body and continually adjusts them to the environment. Some of these experiments have been presented in masterly fashion in his book on "The Integrative Action of the Nervous System" which is universally recognised as the standard work among neurologists. Until recently the mode of working of our sense organs was shrouded in mystery and capable of discussion only in psychological terminology. Prof. Adrian has performed a signal service to science in subjecting so elusive a problem to laboratory treatment. Using biophysical methods, he has, for the first time, been able to bring the sense organs and associated nerves into line with other nervous organs the function of which is better known. His book on "The Basis of Sensation" has provided us at least with a reasonable view based on laboratory experiment.

Nobel Awards in Great Britain

SINCE the foundation of the Nobel Trust in 1901, seventy-six prizes for physics, chemistry and physiology and medicine have been awarded, of which fifteen have gone to scientific men working in Great Britain. The latter are distributed as follows: *Physics*:—Lord Rayleigh (1904); Prof. (now Sir) J. J. Thomson (1906); Prof. (now Sir) William Bragg, jointly with Prof. W. L. Bragg (1915); Prof. C. G. Barkla (1917); Prof. C. T. R. Wilson (1927, jointly with Prof. A. H. Compton, then at the University of Chicago); Prof. O. W. Richardson (1928). *Chemistry*: Sir William Ramsay (1904); Prof. Ernest (now Lord) Rutherford (1908); Prof. Frederick Soddy (1921); Dr. Francis W. Aston (1922); Prof. Arthur Harden (1929, jointly with Prof. von Euler). *Physiology and Medicine*: Sir Ronald Ross (1902); Prof. Archibald V. Hill (1922, jointly with Prof. Otto Meyerhof); Sir Frederick Gowland Hopkins (1929, jointly with Dr. Eijkman); Sir Charles Sherrington and Prof. E. D. Adrian (1932).

Julius von Sachs

THE annual reception given by the president of the Linnean Society, Prof. F. E. Weiss, on October 20, was this year of special interest as it was the occasion of the presentation to the Society on behalf of a number of subscribers of a portrait of the distinguished botanist, Julius von Sachs, painted by his artist daughter Maria Sachs. It is particularly appropriate that this portrait of one of the most eminent of its foreign members should come into the possession of the Society at the present moment,

as this month has seen the centenary of Sachs' birth. In commemoration of this event, two former pupils of Sachs, Dr. D. H. Scott and Prof. F. O. Bower, delivered appreciatory addresses and gave some personal reminiscences of the great plant physiologist. Another former student in Sachs' laboratory, Prof. S. H. Vines, was unfortunately prevented by ill-health from being present but in a written address, which was read at the meeting, he dealt more particularly with the stimulus which Sachs' "Lehrbuch der Botanik" gave to the development of botany in Great Britain. There can be no doubt that, distinguished as he was for his contributions to plant physiology, Sachs was a great all-round botanist and an inspiring teacher, whose influence through the many pupils he attracted to his laboratory from all countries was felt wherever botany was studied.

Industrial Depression and Gold Reserves

A LECTURE by Dr. H. Levinstein on "World Problems of the Chemical Industry" at the Imperial College of Science and Technology on October 27 formed the first of a series of addresses in which men who have won distinction in various fields will present views on industrial affairs to students of the College. Taking the ratio of external trade to population as a measure of the standard of living of a community, Dr. Levinstein showed that more than half the world has a standard which is very much below that of Europe, although the latter is itself far from luxurious. Modern industry has been built up on the assumption that people can be persuaded to buy things which their forefathers did without, and there is no reason for believing that industrial expansion is approaching a limit. The recent setback in the development of world trade, which started with the fall in prices of primary commodities, thereby reducing the purchasing power of the agricultural community and eventually of the whole population, is, in Dr. Levinstein's opinion, a temporary condition brought about mainly by abnormal shifting of gold reserves. There is no actual shortage of available gold deposits. The trouble is due to the removal of gold from where it can perform its proper service to industry. Although the State took charge of the production of munitions during the War, it made no attempt to meet the gold payments demanded by the United States by undertaking extraction of the metal from ore, although this might have been done by working deposits of lower grade than private companies would exploit. Actually, the gold required was taken from reserves and a collapse of trade followed. It was as if a demand to be paid in bricks was met by pulling down houses.

Progressive Chemical Industry

Although gold production is of great importance to industry, as was shown years ago by the effects of the introduction of the cyanide process, Dr. Levinstein said that the human factor is always of vital significance in any consideration of industrial problems. Political economists are apt to forget that men do not always behave in a manner best suited to the furtherance of their economic interests, but are often influenced by fear and prejudice. Science alone builds continuously upon the work of previous investigators, and has a unique record of progressive development. To young men now entering the chemical industry it may seem that opportunities for making profitable discoveries and improvements are becoming less numerous, but Dr. Levinstein said he had heard such views expressed thirty years ago and considers them as false to-day as they were then. There is certainly great scope for fresh ideas and discoveries in the dye-stuff industry, and he believes that the fine chemical industry as a whole offers extensive opportunities to young chemists. Finally, further advances in biochemistry may be expected to open up vast new fields for chemists to explore. Indeed, more precise knowledge of the factors governing the growth of the living cell will undoubtedly lead to great developments in medicine.

The Aircraft Industry and Chemical Engineering

THE value of research in chemical engineering formed the substance of the first Hinchley memorial lecture delivered before the Institution of Chemical Engineers by Mr. H. T. Tizard on October 28. At first sight the aircraft industry seems very remote from the chemical industry, but developments in aeronautics have already been of great value to the chemical industry. Perhaps the most striking example of this may be found in the development of cellulose paints. The possible uses of solutions of nitrocellulose and cellulose acetate were explored on a small scale before the War, but they were first used on the large scale for the protection of the fabric of aeroplanes and balloons. During the War scientific knowledge of cellulose esters accumulated rapidly, and the manufacture of cellulose acetate was begun. The shortage of the usual solvents forced upon us the necessity of trying substitutes, so enlarging our knowledge of cellulosed solutions and preparing the way for the economic production of modern cellulose finishes. The manufacture of cellulose esters and solvents is now one of the most important branches of chemical industry.

THE strong incentive to obtain the highest thermal efficiency in aircraft engines has led to the manufacture and use of lead tetra-ethyl on a large scale. There is now an equally strong incentive to develop heavy oil internal combustion engines for aircraft. It is quite possible that this will only be satisfactorily accomplished if a suitable synthetic chemical compound can be found to promote the smooth combustion of oil when injected into the engine cylinder. Again, the economic success of air transport depends largely on the working life of an engine between overhauls, and this depends mainly on the stability of lubricating oil. The study of lubricants becomes more and more a chemical problem and in future

chemical engineers will have to produce them to precise specifications. One of the most vital problems of the aircraft industry to-day is that of the production of light alloys and prevention of the corrosion of metals and alloys. This is a matter of the widest industrial importance. There are many other ways in which the aircraft industry has already influenced the chemical industry. This influence is bound to persist, since the aircraft industry is not a self-supporting industry, and can only be made self-supporting by intensive scientific investigation of all its problems.

Site of Newcomen's Engine

As is fully recognised to-day, it was the invention of the atmospheric steam pumping engine by Newcomen that saved many mines from closing down and provided for the first time an engine capable of dealing with water in mines of any considerable depth. The first engine of which we have any record is that delineated in the print bearing the inscription "The Steam Engine near Dudley Castle. Invented by Capt. Savery and Mr. Newcomen. Erected by ye latter 1712. Delin: & Sculp: by T. Barney 1719." Two copies of this print are preserved, one in the Birmingham Public Library and the other in the Salt Library, Stafford. There is little contemporary evidence as to the site on which this engine was erected, but in a paper read to the Newcomen Society on October 19, at the Science Museum, Dr. T. E. Lones described how with the aid of documents, local histories, parish registers, rate books, etc., and a study of the geology of the district, he has been led to the conclusion that the engine stood in the parish of Tipton, under which is an inclined seam of coal some 24 ft. thick. On the Birmingham print, besides the many printed references at the side of the drawing of the engine, is the significant manuscript note: "The beam vibrates 12 times in a minute and each stroke lifts 10 gallons of water 51 yards perpendicularly." This appeared to eliminate much of the area in which the coal is found at greater depths than about 150 ft., while further considerations made it possible to determine the position of the engine relative to Dudley Castle. It is, however, probable that unless further documentary evidence, such as might be found in a copy of an old lease, is forthcoming, the exact site will remain unknown. At the conclusion of the meeting it was announced that the next meeting of the Society, on November 16, will be devoted to the reading of a newly discovered diary of the eminent engineer Joshua Field (1787–1863), while the meeting in December will be the Arkwright bicentenary meeting.

Empire Broadcasting

IT is now nearly five years since the experimental short-wave transmitter, operating on a wave-length of 24 metres, was established at Chelmsford primarily for two-way working with America. The station has since been in constant use by the British Broadcasting Corporation for experimental broadcasting to various parts of the world to enable data to be collected on the possibilities of a regular Empire broadcasting service. Following the consideration of a scheme submitted to the Imperial Conference of 1930, it was decided that the British Broadcasting Corporation should establish an Empire broadcasting station at Daventry. The construction of this station is now well advanced and it is expected that the first transmissions will take place about the middle of December. This new station is intended to provide a programme service which will reach the whole Empire at a reasonable listening time, and for this purpose the Empire has been divided into five zones comprising Australasia, India, Africa, West Africa and Canada. The present arrangements provide for a two hours' programme between 6 P.M. and midnight in each zone. Two transmitters of about twenty kilowatts rating are being installed at Daventry; these will be capable of operation on any one of a series of eight selected wave-lengths varying from 14 metres to 50 metres. These transmitters will supply a number of directional aerial systems, the actual wave-length and direction of transmission in use at any time depending upon the zone to which the programme is being sent, and the prevalence of daylight or darkness along the route. The inauguration of the service is now awaited with much interest. It is anticipated that for a period of about six months the service will be experimental and arrangements will be made to collect reports of reception from selected listeners in all parts of the Empire.

College and Faculty Dissociations

MR. A. MOORE HOGARTH, founder and chairman of the College of Pestology (Incorporated), referring to the paragraph entitled "A 'College' in an Office" in NATURE of October 22, informs us that H. W. Blood Ryan is no longer associated with this institution, and that it has had for a considerable time a laboratory, a reading-room and a museum. The registered office of the College is at 52 Bedford Square, W.C.1, and the laboratory for "Pyorrhœa and Skin Clinics" is at 233 Pentonville Road, N.1. Since receiving the above information, the Hon. Secretary of the International Faculty of Sciences has sent us extracts from the records of meetings of the Council of the Faculty held on September 19 and October 10. At the former meeting, a motion was brought forward relating to the professorial title and academic distinctions of H. W. Blood Ryan, and at the special meeting held on October 10 it was resolved that as evidence of these qualifications had not been furnished to the Council, "his resignation from the office of president and fellowship was unanimously accepted by the Council".

IN reply to an inquiry relating to this communication, Mr. Blood Ryan writes as follows: "Although I resigned all connection with the Faculty on October 10th, and the College of Pestology on September 22nd, I am bound to say that I still consider that there exists no other world-wide body attempting to do those things set forth in the prospectus of the Faculty. I was largely responsible for the addition

of the word 'International' to the title, to avoid the obvious danger of misconception which was inherent in title at the time I became associated with the body. In regard to the references to criticisms in *Truth* of the Faculty of Sciences and in your journal some years ago, of The College of Pestology, allow me to say that I am unaware of any such statements, having only joined these bodies early this year."

The Deterioration of Paper on Ageing

THE article on "The Deterioration of Paper on Ageing", which appeared in NATURE of Aug. 27, p. 320, has occasioned some comments from Mr. James Strachan, who is well known in paper-making circles. Mr. Strachan's communication is of particular interest in that it refers to the paper on which NATURE itself is printed. Before 1882 this contained a fairly large proportion of rag, but was replaced from about 1892 onwards by a mixture of esparto and wood. Mr. Strachan points out that the volumes containing rag have a marked tendency to turn brown at the edges of the sheet, whilst the issues for 1892 and 1893 are entirely free from this sign of deterioration. The latter have in fact, even now, as great a bursting-, tensile- and folding-strength as the paper used at the present time. On first consideration these facts appear to make a case for paper containing esparto as distinct from rag. As emphasised in the article, however, the methods of manufacture and storage must also play important parts, and in connexion with the former Mr. Strachan emphasises the formation of hydrochloric acid by the inter-reaction of aluminium sulphate and residual chlorides. So far as the latter is concerned, it may be stated that two sets examined by the writer of the article show distinct signs of browning at the edges even after 1893, and in one case it is extremely difficult to distinguish in this way the rag paper from that containing esparto; these happen to be volumes which are very frequently consulted. Those who possess long runs of NATURE may find some interest in making the comparison for themselves.

"A History of Fire and Flame"

IN reference to the review of this book which appeared in NATURE for October 15 (p. 562), Dr. O. C. de C. Ellis writes to say that it was impossible for him to include the many thousands of references that he had at hand. In doubtful controversies he had had regard to inherent probability, and often, in the absence of definite information, weight was given to accumulations of evidential suggestion. Dr. Ellis considers that, though we do not know that the alchemists experimented with oxygen, we can understand many otherwise incomprehensible passages, in no way interrelated, if we believe that they did. As to the tentative identification of Boyle with "Eirenæus Philalethes", Dr. Ellis still thinks that it is inherently possible that Boyle may have issued treatises under a pseudonym. Upon the material nature of phlogiston, he says that Cavendish and his contemporaries thought at first that hydrogen was phlogiston, and quotes the authority of Stillman for the statement that Stahl approved Becher's characterisation of phlogiston as of an "earthy nature". Dr. Ellis's hypothesis that the alchemists experimented with oxygen is certainly an interesting one, but we feel that more and weightier evidence is required to substantiate it. The problem of the identity of "Eirenæus Philalethes" is extremely obscure, but he was not the same as Eugenius Philalethes (Thomas Vaughan), with whom Dr. Ellis has apparently confused him. Bibliographical references on this point are to be found in Ferguson's "Bibliotheca Chemica", vol. 2, 190–7 (1906).

New International Psychological Journal

Character and Personality is the title of the most recent addition to the number of psychological journals, and it is unique in that it is to appear in English and in German (London: George Allen and Unwin, Ltd., 2*s*.). In the first number, Prof. W. McDougall has an article on the meaning of the title words. He points out the confusion in meaning attached to the word character, and discusses the more common usages. The problem has for the most part been neglected by psychologists. There is also a difference between the English and German use, the former tending to look upon it as representing the single distinctive feature of an individual, the latter as the sum total of those features, properties, or qualities of an individual organism which are peculiar to it and serve to distinguish it from other individuals. Closely allied to, and in popular use frequently indistinguishable from, character is temperament; Prof. McDougall has for years insisted on the use of temperament for the sum total of the effects on the mind of the functioning of the bodily processes, a use which is in accordance with the tradition of centuries (although that does not justify the generalisations of some enthusiasts to the effect that all mental life is entirely dependent on such processes). Workers in applied psychology have been, however, almost forced to use temperament for emotional organisation, but there is no doubt that it would be useful if we did not use character, personality, and temperament as synonyms, but made clear and scientific the implied differentiation; and for this, McDougall's article is excellent.

Physics in Psychical Research

IN the *Hibbert Journal* for October, Prof. D. F. Fraser-Harris contributes an article on what he calls the new era in psychic research. It is an account of the recent experiments with the medium, Rudi Schneider, and a summary of the results which are said to have been obtained in Paris when infra-red rays were interrupted through some agency which appeared to be connected with the medium. Prof. Fraser-Harris, in his description of some of the more startling phenomena that he has himself observed, does not seem to have cherished many doubts as to the 'super-normal' character of the occurrences. He states that there have never been suspicions of the medium himself when examined outside the latter's

home, although the facts are that the surreptitious freeing of one hand from the controllers was made the subject of heated controversy in 1924 and has been suggested many times since as the means whereby certain of the minor 'phenomena' were produced. Prof. Fraser-Harris concludes by the plea that these occurrences are worthy of scientific examination and that this demonstration of exteriorised energy opens up a new era in psychical research. He appreciates the difficulties both from the point of view of the physiologist and that of the physicist, but is of the opinion that the way is now open for the independent verification of the disputed phenomena. Certainly if the recent claims made by MM. Osty on behalf of the medium can be substantiated, then an important step forward has been made.

Life-Saving Appliances on Merchant Ships

THE Royal Society of Arts has several times given awards for inventions in connexion with life-boats and in 1878 it appointed a committee to consider marine life-saving apparatus. Its interest in nautical affairs is also shown by the Thomas Gray lectures, which were this year given by Capt. O. A. Barrand and Mr. G. A. Green on life-saving appliances on merchant ships, reports of which have now appeared (*J. Roy. Soc. Arts*, Sept. 16, 23, 30, Oct. 7). The lectures were divided into sections dealing with life-buoys and life-jackets, coastal life-boats, ships' boats, boat stowage and buoyant apparatus. The credit for the design of the "Standard" life-jacket, we learn, belongs to certain officers of the Board of Trade, but jackets can be manufactured by anyone if permission is obtained. The best jackets are now of 'kapok', which when suitably packed has a buoyancy value of 3½ times that of cork. Kapok is the seed-hair of a plant growing in the East, but only Java kapok is permitted in life-jackets. The tests for jackets are stringent and the Standard jacket has to contain 24 oz. of the best Java kapok and to be capable of supporting 20 lb. of iron after floating in fresh water for 24 hours with 16½ lb. of iron attached. The loss of buoyancy of Java kapok has been shown to be only 10 per cent in thirty days' immersion.

Annual Weather Report

THE recently published annual volume of the *Weekly Weather Report* (London: H.M. Stationery Office) is the fifty-fourth annual summary of weather recorded at official weather stations or stations maintained by private individuals in co-operation with the Meteorological Office, in which the week is made the unit of time. Until recent years, summaries of individual weeks were printed within a short time after the conclusion of each week, but since that was discontinued, advantage has been taken of the opportunity thereby afforded of presenting a whole year's data in a form that should be extremely handy for the statistician who seeks to relate agricultural statistics of crops with the weather. The week has for long been held by many meteorologists to be the ideal unit of time in agricultural meteorology, and the *Weekly Weather Report* has always aimed at being the farmer's weather report. This explains why in this latest volume the period begins on March 1, 1931, and ends on February 27, 1932, so as to cover a farmer's year. The main features of the weather of the whole year for any one of the twelve 'districts' into which the British Isles are divided are readily seen by the inspection of a few columns of figures, occupying only one-third of a page. Where the progress of events for a single place are of more interest, recourse has to be made to the weekly figures for the sixty individual representative stations, which are set out so that one page shows all the figures for one station only. In this particular volume the widespread incidence of abnormally cold and wet weather during the harvest period of 1931 over England is one of the most striking features; the general character of the phenomenon is shown by the weekly deviations of temperature and rainfall for English 'districts', and one can compare its severity at places so far apart as Durham and Jersey. The corresponding figures for Scotland and Ireland show the varying extent to which the northern parts of those countries escaped this visitation.

Radium in Great Britain

IN the Third Annual Report of the National Radium Trust and Radium Commission, 1931–1932 (H.M. Stationery Office. Price 9*d*. net), details are given of the purchases of radium by the Trust, and of the distribution of the supply by the Commission. We gather that the supply of national radium amounts to about 19 gm., excluding 4 gm. formerly comprising the 'bomb', now acquired by King Edward's Hospital Fund for London. The cost of this supply with the necessary containers has amounted to £217,937. It is noted that in spite of the stress laid by the Commission upon the necessity for the observance of the approved precautions for the safe custody of radium, avoidable losses have occurred at three of the national centres, which the Commission regards as resulting from breaches of the radium regulations. The reports deal only with administrative matters and no details of treatment are included.

Seeding of Frog-bit in Great Britain

MISS GLADYS V. HOARE writes from the Royal Holloway College, Egham, Surrey, that plants of frog-bit (*Hydrocharis Morsus-ranæ*) under observation in the Botany Garden of the College have recently set seed. This is worthy of note since the plant usually reproduces itself vegetatively by means of turions, and reproduction by seed has not been reported for Britain by such well-known authorities as Sir Joseph Hooker and Mrs. Arber. In fact, it is frequently stated that the fruit is rare in Great Britain. Mr. Wilmott of the Natural History Museum showed Miss Hoare four seeds sent to him by Miss Corfe from Glastonbury in 1926. Miss Hoare suggests a connexion between this seedling and the special condition of the summer weather, and would be glad to know whether any other naturalist has collected seeds this year.

Inhalation of Oxygen

SIR LEONARD HILL described in NATURE of September 10, p. 397, some interesting experiments bearing upon "Altitudes to be Reached by Air Pilots by Breathing Oxygen". Dr. Elihu Thomson, General Electric Company, Lynn, Mass., writes to direct attention to a paper communicated by him to the *Medical Times*, Philadelphia, of November 15, 1873, entitled "Inhalation of Nitrous Oxide, Nitrogen, Hydrogen and Other Gases and Gaseous Mixtures", dealing with the same or similar subjects. Dr. Thomson was one of the first to realise the principle, which Paul Bert experimentally and successfully tried at about the same date, of using oxygen for high altitudes.

Chance-Parsons Optical Glass

ARRANGEMENTS have been made whereby in future there will be very close co-operation between the firm of Messrs. Chance Brothers and Co., Ltd., Birmingham and the Parsons Optical Glass Company. For some time it has been evident that considerable saving in the manufacture of optical glass could be effected by pooling the knowledge of the two firms and by concentrating the production in one establishment. Under this arrangement all optical glass will be made at Messrs. Chance's Smethwick Works under the joint supervision of the present manager, Mr. W. N. Wheat, and of Mr. H. C. Rands, who, under the leadership of the late Sir Charles Parsons, has been largely responsible for the development of the Parsons Optical Glass Company.

Announcements

LORD MACMILLAN has agreed to succeed Lord D'Abernon as president of the National Institute of Industrial Psychology. Lord D'Abernon, who has had to resign owing to pressure of other engagements, succeeded Lord Balfour in 1930.

THE eighth annual Norman Lockyer lecture of the British Science Guild will be delivered by Sir Frank Smith in the Goldsmiths' Hall, Foster Lane, London, E.C.2, on November 22, at 4.30 P.M. Sir Frank will speak on "Industrial Research and the Nation's Balance Sheet".

THE Priestley Medal of the American Chemical Society has been awarded to Dr. Charles L. Parsons, formerly chief mineral chemist and chief of the Division of Mineral Technology of the United States Bureau of Mines, Washington. Dr. Parsons has been secretary of the Society for twenty-five years.

SIR ARTHUR EDDINGTON will deliver an address on "Physics and Philosophy" under the auspices of the British Institute of Philosophy at University College, Gower Street, W.C.1, on Tuesday, November 15, at 8.15 P.M. The chair will be taken by Bertrand Russell. Tickets can be had on application to the Director of Studies, University Hall, 14 Gordon Square, W.C.1.

THE fourth Liversidge lecture founded in accordance with the will of the late Prof. A. Liversidge, of the University of Sydney, will be given before the Chemical Society in the Medical Lecture Theatre, The University, Edmund Street, Birmingham, on November 25, at 5.30 P.M., by Dr. F. W. Aston. The title of the lecture is "Physical Atomic Weights". Admission is free, without ticket.

AT the annual general meeting of the Cambridge Philosophical Society held on October 24, the following officers of the Society for the ensuing session 1932–33 were elected: *President:* Prof. A. Hutchinson; *Vice-Presidents*, Mr. F. T. Brooks, Dr. F. H. A. Marshall, Dr. F. W. Aston; *Treasurer*, Mr. F. A. Potts; *Secretaries*, Mr. F. P. White, Dr. J. D. Cockcroft, Dr. H. Hamshaw Thomas; *New Members of the Council*, Prof. D. Keilin, Mr. J. A. Steers, Mr. M. H. A. Newman, Mr. P. M. S. Blackett.

AT the annual general meeting of the North-East Coast Institution of Engineers and Shipbuilders which was held on October 28, the following awards were made, among others: Institution Gold Medal in engineering to L. J. Le Mesurier and R. Stansfield for a paper entitled "Combustion in Heavy Oil Engines"; and the Institution Gold Medal in shipbuilding to Dr. F. H. Todd for a paper entitled, "Some Measurements of Ship Vibration".

MESSRS. W. HEFFER AND SONS of Cambridge have issued a new catalogue (No. 393) which will be a useful reference list for libraries, institutions and collectors. It includes transactions of learned societies, library editions and standard books in literature, historical, scientific, oriental and general, English and foreign; and its 154 pages comprise 2786 entries.

A COMPLETE Index of twenty volumes of the *Transactions and Proceedings of the Geological Society of South Africa* (vol. 14 (1911) to vol. 33 (1930) inclusive) has been prepared under the auspices of the council of the Geological Society of South Africa and is now available on application to the Assistant Secretary, Geological Society of South Africa, Box 1071, Johannesburg, Transvaal, South Africa, at a cost of 25*s.* a copy.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chemist and manager of the Wood End Sewage Disposal Works—The Borough Engineer and Surveyor, Town Hall, Burnley (Nov. 7). A senior assistant civil engineer for steel and reinforced concrete structures and a junior and a senior civil engineer for civil engineering works in the Government of Northern Ireland—The Principal Establishment Officer, Ministry of Finance, Stormont, Belfast (Nov. 10). A lecturer in physics and mathematics at the College of Technology and Art, Rotherham—The Director of Education, Education Offices, Rotherham (Nov. 12). A lecturer in mathematics at the Huguenot University College (University of South Africa), Wellington—The Registrar (Dec. 15). A junior assistant metallurgist at the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

'Protective' Adaptations of Animals

IN a recent issue of NATURE,[1] "B. P. U." makes the following challenging statement: "The whole of the book is full of examples—most carefully collected and thoroughly analysed, and represents an array of arguments of which selectionists will find it very difficult to dispose." Unfortunately, the book[2] to which reference is made is not yet available here, but it would appear from the information given by "B. P. U." that the claim made in this quotation is not supported by the facts. While it is evident that the book contains a vast array of statistical data on the contents of birds' stomachs, no mention is made of a similarly exhaustive survey of the food that was available to the birds, and, in fact, it is inconceivable that such a survey could be made adequately. When the statistical data deal only with the contents of birds' stomachs, and there is no quantitative information about the available food, how is it possible to claim that "The principle of proportional predation is exhibited so clearly and forcefully that a discrimination in the choice of prey by birds—is shown to be simply non-existent"? The examination of the stomach contents of birds, by itself, can give no evidence for the existence of "proportional predation", and so such work can throw no light upon the process of natural selection.

The arguments given by "B. P. U." appear to be based upon the generally accepted hypothesis that an adaptation must confer a general benefit upon a species if it is to be selected. Some years ago I showed[3] that this hypothesis is not only unnecessary, but is misleading, and is the cause of much of the criticism to which the theory of natural selection has been subjected. For selection it is necessary that mutant individuals should possess an *immediate* advantage when competing with their normal fellows, but this is all. For example, let us suppose that 'warning coloration' appears as a mutation. For the displacement of the original by the mutant type it is merely necessary that some one of the many species of natural enemies should occasionally fail to attack an individual on account of its 'warning coloration'. So long as the original and mutant types competed, this *relatively* greater survival value would be maintained, so that eventually the original would be displaced by the mutant type. After this displacement, the reduction in the intensity of the attack of the natural enemy that acted as selective agent would tend to increase the density of the species. Thus it is likely that natural selection would increase the number of individuals of the prey-species available to those natural enemies that are unaffected by the 'warning coloration'. Why, then, claim that the presence of 'warningly coloured' insects in the stomachs of large numbers of birds proves that this 'protective adaptation' could not have been preserved by natural selection?

When the selection of improved adaptation reduces the severity of the action of one of the controlling factors, this merely *tends* to increase the population density. Actually, such selection disturbs a complex system of interacting equilibria, and the position at which balance is re-established may be quite different from what one would expect from a knowledge of the direct effects of the adaptation. For example, suppose that a population of foxes is held in check by the availability of rabbits, and that mutation causes the appearance of some foxes that are more efficient in finding rabbits than are their normal fellows. Clearly, the mutant type will eventually displace the original type of fox, but what is the result? The fox population now searches with increased efficiency, thus reducing the population density of rabbits. But the individual foxes need just as much food as before, so, since there are less rabbits to eat, the population density of foxes must be less than it was originally. So natural selection itself may reduce populations.

This view of natural selection is clearly dependent upon the belief that animal populations exist in a state of balance, which, it may be remarked, does not necessarily mean that animals maintain constant population densities. This belief is often disputed, but it is supported by general observation, and by such experiments as have been carried out under suitable conditions (c.f. Chapman,[4] Holdaway,[5] Pearl[6]). Also, we know that competition is of the greatest importance in limiting populations, and in a forthcoming publication I shall show, with much more evidence than I have already[3] given, that this necessarily leads to balance. Natural selection merely selects; it does not produce the 'balance of Nature' by causing the properties of each species to balance those of the environment, as appears often to be supposed. Nor does it necessarily favour the success of a species, but merely gives an *immediate* advantage to the more perfectly adapted individuals over their less perfect brethren.

A. J. NICHOLSON.

Division of Economic Entomology,
Council for Scientific and Industrial Research,
Canberra.

[1] NATURE, vol. 130, pp. 66–67, July 9, 1932.
[2] Smithsonian Miscellaneous Collections, vol. 85, No. 7.
[3] *Australian Zoologist*, vol. 5, part 1, pp. 10–104, Nov. 1927.
[4] *Ecology*, vol. 9, No. 2, pp. 111–122; 1928.
[5] *Ecological Monographs*, vol. 2, pp. 261–304.
[6] "The Biology of Population Growth". Williams and Norgate, Ltd., London, 1926. Chaps. i and ii.

MY review[1] of McAtee's work[2] on the effectiveness of so-called 'protective' adaptations in animals was written to direct the attention of naturalists to a unique accumulation of facts bearing on a problem which it has become customary to regard as solved in accordance with certain preconceived dogmas. That the paper in question does deserve this attention is proved by the replies and comments aroused by my review. Although the review contained only a brief and almost verbatim representation of the chief facts and conclusions reached by McAtee and not of my own views (which, I admit, are close to his), the critics did me the honour of addressing their replies to me, and I feel bound to answer them, while I hope that McAtee himself will not fail to express his views on the criticisms offered.

Prof. Poulton's[3] comments refer to a particular point (birds' attacks on butterflies), which is scarcely touched upon by McAtee and not discussed at all by me. The allegation that I am "willingly misrepresenting" the opinions of others is based on a

sentence in my review which was taken almost verbatim from the original paper.

Prof. Huxley[4] commits a fundamental fallacy in ascribing to me the views I have never held or expressed. He discusses the problem of adaptations in general and maintains that each particular adaptation is partial and relative. I have given Prof. Huxley no reason for thinking that my views on this point are different, but these obvious generalities have nothing to do with our problem, namely, whether the so-called 'protective' adaptations in animals deserve that name by protecting the animals from being attacked by enemies and to what extent. Figures quoted by McAtee supply some most interesting data in this direction and they show that the numbers of insect species found in birds' stomachs are roughly proportional to their numbers in Nature. This is a definite fact and one cannot dispose of it by quoting an imaginary example of the number of would-be wrecked ships, which, in Prof. Huxley's opinion, should be in proportion to the number of ships of the respective type.

With reference to ants as a classical example of "specially protected" animals, Prof. Huxley appears to have overlooked the figures I have quoted, namely, that more than three hundred species of American birds (out of the total number of about eight hundred species including non-insectivorous ones) feed on ants and some of them consume thousands of individuals. This cannot be interpreted to mean that "most birds" reject ants and that ants are particularly immune from their attack. It is interesting in this connexion to quote another paper by Cott[5] who has found that ants constitute more than 90 per cent of the food of frogs. In face of such facts, the whole elaborate theory of 'ant-mimicry' as a protective adaptation assumes the aspect of a beautiful fairy-tale.

Much more serious and well-founded criticism of McAtee's statements and conclusions can be found in the first paragraph of Mr. Nicholson's letter above, in which it is pointed out that a mere accumulation of data on the contents of birds' stomachs, without a similarly exhaustive survey of the food that was available to birds, cannot be considered as evidence of proportional predation. It is fair to state that Mr. Nicholson's letter was based only on my review and not on the original paper by McAtee, who himself stresses the same point and admits the approximate value of his figures, which serve merely to indicate roughly the correlation between the 'protective' adaptations of animals and the degree of protection they confer on their bearers. No such correlation appears to exist and this fact cannot be ignored.

The rest of Mr. Nicholson's letter represents a most typical example of attempting to solve biological problems by logical reasoning based on purely theoretical assumptions. This type of argument, starting with "let us suppose" and continuing with what would happen as a logical result, does not appeal to a naturalist who values facts more than philosophical discussions. The great problem of natural selection has always served as a favourite subject for such discussions, but it is time that attempts were made to elucidate it by an unbiassed accumulation of facts.

To conclude, I should like once more to direct the attention of biologists to McAtee's paper. Not all of his conclusions will be found acceptable to everybody, but an immense amount of valuable facts is there. These facts can be analysed from various points of view and perhaps different conclusions will be reached, but to disregard them would be unscientific.

B. P. UVAROV.

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British Museum (Natural History),
Cromwell Road,
London, S.W.7.
Oct. 7.

[1] NATURE, vol. 130, p. 66, July 9, 1932.
[2] Smithsonian Miscellaneous Collections, vol. 85, No. 7. Washington, 1932.
[3] NATURE, Aug. 6, p. 202.
[4] NATURE, Aug. 6, p. 203.
[5] *Proc. Zool. Soc. Lond.*, p. 471; 1932.

Hyperfine Structures of Antimony Lines and the Nuclear Moments of Antimony Isotopes

THE hyperfine structures of a number of Sb II lines in the visible region have been investigated by me. As a light-source was used a lamp of the mercury arc type, and Fabry-Perot etalons, silvered by Dr. Ritschl's process,[1] in conjunction with a Zeiss three glass prism spectrograph served to resolve the fine structures. Aston[2] has found that antimony has two isotopes of mass numbers 121 and 123. The hyperfine structures lead to the assignment of a nuclear moment corresponding to $I = 5/2$ to the more abundant isotope Sb^{121} and $I = 7/2$ to the isotope Sb^{123}. No relative shift in the fine-structure patterns of the two isotopes has been observed.

The splittings of the terms show a similarity with those of terms of corresponding configurations of other spectra and indicate that in the gross structure *the coupling is more of the J–J type. Of all the* configurations the (sp^3) seems to have the largest interaction with the magnetic nucleus, since of all the observed terms the $(5s\,5p^3)\,^3D_3$ term shows the largest splittings, namely, 3·05 cm.$^{-1}$ and 2·23 cm.$^{-1}$ for Sb^{121} and Sb^{123} respectively. Prof. R. J. Lang very kindly allowed me the use of his unpublished data on the gross structure of the spectrum Sb II, and the interpretation of the hyperfine structures has been helpful in modifying and extending these to some extent.

The structures of some of the arc lines in the ultraviolet have also been investigated using a Hilger reflecting echelon in addition to Fabry-Perot etalons silvered by Dr. Hochheim of the I. G. Farbenindustrie. Details are being sent in for publication in the *Zeitschrift für Physik*.

J. S. BADAMI.

Laboratorium des Präsidenten,
Physikal-Technische Reichsanstalt,
Berlin-Charlottenburg,
Sept. 23.

[1] Ritschl, *Z. Phys.*, **69**, 578; 1931.
[2] Aston, *Proc. Roy. Soc.*, A, **132** 487; 1931.

Influence of Light on Paramagnetic Susceptibility

RECENTLY C. J. Gorter,[1] continuing the experiments of Bose and Raha on the change in the susceptibility of paramagnetic ions under the action of light, has demonstrated, in a manner which may be considered definitive, that the observed diminution in paramagnetic susceptibility is to be attributed, according to the Curie-Weiss law, to the rise of temperature of the solution produced by the absorption of light.

In an analogous research carried out last year by me,[2] by Quincke's method of capillary ascension, and measuring the displacement of the liquid column under the influence of the magnetic field by means of an arrangement including a photoelectric cell connected with a galvanometer through an amplifying audion circuit, I predicted the difficulty of separating the Bose effect from the thermal effect, both in the same sense, and the latter certainly stronger.

Experiment confirmed this prediction, since the change in susceptibility which I observed when the light of a mercury arc was concentrated on a solution of chromic sulphate, *a change which increased with the time*, could not but be interpreted, as I interpreted it, as due to pure thermal effect.

I also succeeded, however, in bringing to light another fact: a very small increase of magnetic susceptibility of the solution, which manifested itself immediately the solution came under the influence of light, and rapidly disappeared, to give place to the variation of opposite sense due to thermal effect. Of this increase in susceptibility it is difficult to give a plausible explanation: given the characteristic of variability in the magnetic moment of the ions of the first transition series, a characteristic which is bound up with the presence in the solution of complex ions, the facts might perhaps point to some influence of light on the concentration of such ions.

O. SPECCHIA.

Istituto Fisico A. Righi,
Bologna.

[1] C. J. Gorter, NATURE, 130, 60, July 9, 1932.
[2] O. Specchia, *Nuovo Cimento*, 8, 291; 1931.

Crystal Structure and Dehydration Figures of Alkali Halide Hydrates

MEASUREMENTS of the cell dimensions of sodium bromide and sodium iodide dihydrates have been made by means of Weissenberg and oscillation photographs about the crystallographic axes. The results are as follows:

$NaBr.2H_2O$. Monoclinic. $a = 6{\cdot}59$, $b = 10{\cdot}20$, $c = 6{\cdot}51$ A.u. $\beta = 112{\cdot}5°$. $a : b : c = 0{\cdot}646 : 1 : 0{\cdot}638$. The probable error is about 0·5 per cent. The axial elements given by Groth[1] are $a : b : c = 0{\cdot}6469 : 1 : 0{\cdot}6335$, $\beta = 113° \ 13'$. The number of molecules per cell is 4. The density calculated from these values is 2·28; in the literature[2,3], the values given are 2·34 and 2·165 at 16·8°C. The halvings observed are $(h01)$ when h is odd and $(0k0)$ when k is odd. Hence, the space-group is $C_{2h}^5 - P2_1/a$.

$NaI.2H_2O$. Triclinic. $a = 6{\cdot}85$, $b = 5{\cdot}76$, $c = 7{\cdot}16$ A.u. $\alpha = 98°$, $\beta = 119°$, $\gamma = 68\frac{1}{2}°$. Hence $a : b : c = 1{\cdot}190 : 1 : 1{\cdot}243$. The probable error is about 0·5 per cent. The number of molecules per cell is 2 and the space-group $C_i^1 - P\bar{1}$. The density calculated from the above values is 2·67, whilst that given in the literature[3] is 2·448 at 20·8°C.

Both substances are deliquescent, and it is difficult to free the crystals from adhering mother liquor. This probably explains why the formula given by Favre and Valson[3] was $NaI.4H_2O$. The X-ray measurements show that this formula is improbable, because the minimum volume occupied by all the atoms in the unit cell would be 266 cubic A.u., whereas the actual volume is 230 cubic A.u. The density determination by these authors is also probably in error because of the same difficulty.

The structure of $NaCl.2H_2O$ has not yet been investigated because it decomposes rapidly at ordinary temperatures but work on it is in progress.

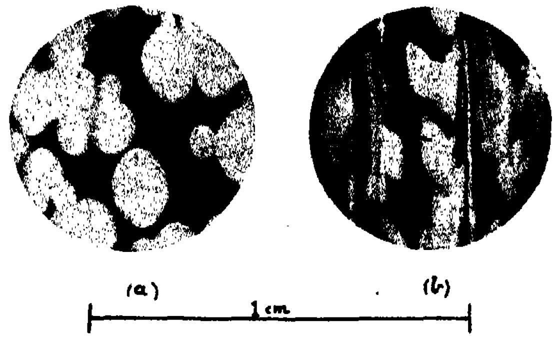

FIG. 1.—Dehydration figures of (*a*) $NaBr.2H_2O$ (20 hours over calcium chloride) and (*b*) $NaI.2H_2O$ (4 weeks over calcium chloride).

Both the hydrates show well developed dehydration figures when allowed to stand over calcium chloride for about twenty hours in the case of the bromide and for four weeks in the case of the iodide. The dehydration starts at points on the surface and spreads out forming very shallow white elliptical patches. Photographs are shown in Fig. 1. It is hoped that a full account of this work, together with the relation of the dehydration figures to the crystal structure, will shortly be published in the *Zeitschrift für Kristallographie.*

W. A. WOOSTER.

Department of Mineralogy and Petrology,
Cambridge,
Sept. 28.

[1] Groth, "Chemische Krystallographie", vol 1, p. 234.
[2] Playfair and Joule, *Mem. Chem. Soc.*, 2, 401.
[3] Favre and Valson, *C.R.*, 77, 579.

Magnetic Constants of Benzene, Naphthalene and Anthracene Molecules

IN a recent communication[1], I have shown how, by a correlation of the principal susceptibilities of a diamagnetic crystal, with those of the constituent molecules, it is possible to determine the orientations of the molecules in the crystal. Conversely, where the orientations are already known from X-ray measurements, we can calculate the molecular magnetic constants from those of the crystal. The principal susceptibilities of naphthalene and anthracene molecules, calculated in this manner, are given in the following table. Two of the magnetic axes of the molecules lie in the plane of the benzene rings, one along the line joining the centres of the rings and the other perpendicular to this line. The third axis is normal to the plane of the rings. The susceptibilities along these axes, per gram molecule, are denoted by K_1, K_2 and K_3 respectively. The values for the benzene molecule, which are also included in the table, have been calculated (in the

Molecule	$-K_1 \times 10^6$	$-K_2 \times 10^6$	$-K_3 \times 10^6$
Benzene	37·3	37·3	91·2
Naphthalene	39·4	43·0	187·2
Anthracene	45·9	52·7	272·5

absence of magnetic data for the crystal) from

measurements on magnetic double refraction and on light scattering in the liquid state; the calculation is possible since the molecule may be assumed to have an axis of symmetry.[2]

It is remarkable that the numerical increase in susceptibility as we proceed from benzene to naphthalene and from naphthalene to anthracene is practically confined to one direction, namely, that which is normal to the plane of the molecules.

Also the normal to the plane is an axis of approximate magnetic symmetry; the ratio of the susceptibility along this axis to that in perpendicular directions increases from 2·4 in benzene to 4·5 in naphthalene and 5·5 in anthracene. It would be of interest to verify by measurements on molecules with continually increasing number of benzene rings in a plane, whether this ratio would reach a limiting value; and whether the limiting value would coincide with the observed value (about 10) of the ratio for carbon in graphite.

K. S. KRISHNAN.

Physics Laboratory,
University of Dacca,
Sept. 23.

[1] NATURE, **130**, 313, Aug. 27, 1932.
[2] C. V. Raman and K. S. Krishnan, *Proc. Roy. Soc.* A., **118**, 511; 1927.

Efficiency of the Geiger-Müller Counter

WITH reference to the letter by Dr. J. C. Jacobsen in NATURE of October 15, I am glad to note that the experiments referred to confirm results obtained by me two and a half years ago by the same method[1], namely, that the efficiency of the Geiger-Müller counter increases at first as the voltage is increased and finally approaches unity.

To this previous result I may now add that the efficiency of the counter does not vary when the thickness of the wall is very markedly reduced; which proves that the discharge in the tube is actually due to the direct ionisation of the primary cosmic rays and not to some softer secondary radiation generated by the primary rays in the wall of the tube.

This was shown by the following experiment: three Geiger-Müller counters were placed one above the other with their axes in the same vertical plane; the middle counter had its wall formed by an aluminium leaf only 7 μ thick and was enclosed in a glass cylinder (in which the air was exhausted to a pressure of 7 cm. Hg) of large diameter, so that a secondary particle generated in the glass had but a small probability of entering in the counter. A brass tube 1 mm. thick could be brought to cover the counter or be moved away by inclining the whole apparatus. The frequency of the triple coincidences was in both cases practically the same.

BRUNO ROSSI.

Laboratorio di Fisica della
R. Università, Arcetri, Firenze.
Oct. 16.

[1] *Rend. Lincei*, **11**, 831; 1930.

Secondary Radiation Produced by Cosmic Rays

ON August 12, the date on which Regener obtained his very high-altitude cosmic ray data, using self-recording apparatus carried by a balloon,[1] measurements were made on a mountain-top in the Himalaya at an altitude of about 19,500 ft. The results of these measurements indicate clearly that the ionisation of gas in an ionisation chamber is due at least in part, if not entirely, to a secondary radiation produced in the walls of the chamber and other surrounding media, by cosmic radiation.

The apparatus used consisted of a Lindemann electrometer with a thin-walled aluminium ionisation chamber and six screens of different materials. The screens were made as nearly as possible of equal size and weight so that the mass per unit area was the same for all. The screens should, therefore, according to the usual assumption, have had equal absorption effects. Readings taken with and without screens surrounding the ionisation chamber show that the presence of a thin screen of heavy metal actually increases the rate of ionisation, while the effect of a paper screen is to decrease the rate of ionisation.

The following table gives the results obtained for the six screens used:

Various Shields Used.	Time for Given Voltage Drop.
With no Shield	100 seconds
Paper Shield	104·4 ,,
Aluminium Shield	100·6 ,,
Zinc Shield	92·3 ,,
Iron Shield	100·5* ,,
Iron Shield	92·1 ,,
Copper Shield	92·8 ,,
Lead Shield	82·0 ,,
Iron over Lead (Double) Shield	79·0 ,,
Lead over Iron (Double) Shield	82·3 ,,

* The iron shield was the first to be used so that the first value, 100·5 sec., may have been obtained before the sensitivity of the electrometer became steady. The lower value is probably more nearly correct.

It will be noticed that the heavier metals produce the greater positive effects. Presumably increasing the thickness of the screens would increase the effect, though of course in each case within definite limits. The mass per unit area of the screens used is about 0·9 gm./cm.

The above results may help to explain the discrepancies between the high altitude curves obtained by Kolhörster, Regener, and Piccard, for it is obvious that the density and thickness of the ionisation chamber walls must have a considerable effect on the shape of the curves obtained by different instruments. This is probably especially true at very great altitudes.

J. M. BENADE.

Physics Department,
Forman Christian College,
Lahore. Oct. 2.

[1] NATURE, **130**, 364, Sept. 3, 1932.

Retention of Moisture by Wood

IN many respects, wood behaves as a hydrophilic swelling gel. Thus, the specific volume of the wood water aggregate at various moisture contents has been measured on extracted spruce wood flour by Volbehre[1] and found to be less than that given by the simple volumetric proportions of the two components, from the dry state up to about 20 per cent moisture content (based on the dry weight of the wood). That is to say, volumetric contraction is observed as nearly as experimentally possible up to the fibro saturation point. Again, Pidgeon and Maass[2] have measured the vapour pressure isothermals of spruce and found the typical curves for a swelling gel. While the former experiment points to the existence of a loose

chemical bond between the water and the wood, the latter authors draw the conclusion that all the moisture above about 2 per cent is held by capillary forces due to the curvature of the water menisci in the micellular structure.

Experiments are being carried on at this Laboratory in the hope of distinguishing between these two effects. If the moisture below the fibre saturation point is retained by capillary action, then, when wood flour is completely flooded by water under a high vacuum, the capillary menisci will no longer exist and, on this hypothesis, any experiment designed to detect an attraction between the wood and the water would yield a nul result. If, however, the retention is due to surface adsorption, it should be observable even in this case of complete immersion.

Sitka spruce flour (60–80 mesh) is dried to constant weight in a high vacuum over phosphorus pentoxide and flooded with evacuated sucrose solution of known concentration. (In certain cases, the wood, after evacuation, was given an initial moisture content by being put in vapour communication with distilled water.) The amount of water leaving the solution in favour of the wood is calculated from the change in refractive index of the solution as measured, by comparison of the solutions before and after being mixed with the wood flour, on a Rayleigh interference refractometer. Changes in refractive index occurring in the sixth place of decimals may be measured, the adsorption usually affecting the fourth place. The corresponding concentration changes may be measured accurately to about 0·002 per cent, the adsorption affecting the concentration by an amount in the order of 0·1 per cent.

This method, details of which will be published later, has the advantage over cryoscopic methods such as that of Newton and Gortner[3] in that it is applicable over a range of temperatures and that changes in concentration required for measurable results are very small.

The preliminary results, carried out at room temperature (19°–21°C.) and corrected as accurately as possible for the refractive index of the wood extractives are as follows.

Solution Concn. (gm. water in 100 gm. solution).	Initial moisture content of flour.	Adsorption as per cent of dry weight of flour.
70·3	zero	19·5
	11·4 per cent	19·1
81·0	zero	21·3
84·4	zero	20·2
	12·2 per cent	20·4
90·5	zero	19·0
	13·5 per cent	20·0

Average, 19·9 per cent.

The figures from which these averages are taken range from 18·2 to 21·6 per cent adsorption, though with improvement in technique this variation is being reduced.

If sugar is adsorbed as well as water, the true water adsorption will be greater, not less, than the apparent adsorption calculated above. Since no sensible difference has been found between the results for varying proportions of solution and flour, or for varying concentrations of solution, the adsorption of sugar may be taken as very small—this point is receiving further attention. Sucrose was chosen as control solution because, since the natural extractives of the wood frequently contain carbohydrates, the probability of further chemical action between the wood and the solution is remote.

A few adsorption experiments have also been made on Whatman filter paper, which show an adsorption of 10·0 per cent. These adsorption measurements will be repeated on standard cotton cellulose.

The fibre saturation point is that point on the vapour pressure isothermal above which the moisture content becomes independent of the external vapour pressure, that is, the point at which the curve becomes virtually parallel to the moisture content axis. On the isothermals of Pidgeon and Maass, this point is reached at about 24 per cent for spruce and at about 12 per cent for cotton cellulose (both measured in vacuo at 23°C.). For spruce these are probably the most reliable measurements available.

The results of the present experiments are of interest in indicating that, under complete immersion, a quantity of water, almost equal to that held at the fibre saturation point, is retained by the wood under the action of non-capillary forces which are great enough to overcome the attraction of sugar for water in solution. From this we may infer that wood, holding water against a lowered vapour pressure, and not immersed, will also do so by the same forces. That these non-capillary forces are due to true surface adsorption appears most probable from these experiments.

When the capillary radii, required to account for capillary adsorption, are calculated for spruce, the values obtained[2] run from about $4{\cdot}5 \times 10^{-8}$ cm. to $3{\cdot}8 \times 10^{-6}$ cm. according to the vapour pressure. Since the lower of these values is so near the radius of the hydrogen molecule, there seems to be some doubt about the applicability of thermodynamical capillary laws in this instance and the explanation of the vapour pressure isothermals in terms of surface adsorption up to, or near, the fibre saturation point seems preferable.

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Oct. 7.

[1] Volbehre G. B., Dissertation for Doctorate, Kiel, 1896.
[2] Pidgeon and Maass, *J. Amer. Chem. Soc.*, **52**, 3, 1053–1069; 1930.
[3] Newton and Gortner, *Bot. Gaz.*, **74**, 442–446; 1922.

Adrenal Cortical Extracts and Sex Changes

THAT there is a relationship between the adrenal cortex and the sex functions has long been inferred from clinical observations, although until recently there has been little direct experimental evidence to support this view.

Corey and Britton[1] found that precocious maturation of sex glands of young albino rats followed the injection of extracts of the adrenal cortex, prepared by the method of Swingle and Pfiffner.[2]

Connor[3] with the rat, and more recently Cleghorn[4] with the mouse have been unable to confirm this, however.

We have also been unable to demonstrate any effect of the injection of Swingle and Pfiffner's extract on the sex function of the mouse. The extract used (which was kindly supplied by Mr. N. Evers), was 'Eucortone', prepared by Messrs. Allen and Hanbury. As has been shown in this laboratory, Eucortone is capable of keeping completely adrenalectomised cats alive for long periods.

We found that the daily injection of 0·5 c.c. of Eucortone subcutaneously failed to produce precocious maturity in female mice as judged by the weight of the animal and time of opening of the vagina, compared with that of controls, and also did not affect the normal course of œstrus in the adult female. No difference was observed between male mice receiving injections of Eucortone, and controls receiving the same amount of saline.

In view of the evidence of Connor[3], Asher and Klein[5] and others that aqueous adrenal cortical extracts are potent to produce experimental sex changes, the suggestion that the adrenal cortex secretes two distinct hormones must be seriously considered.

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[1] Corey, E. L., and Britton, S. W., *Amer. J. Physiol.*, **99**, 33; 1931.
[2] Swingle, W. W., and Pfiffner, J. J., *Amer. J. Physiol*, **96**, 153; 1931.
[3] Connor, C. L., *Proc. Soc. Exp. Biol. Med.*, **29**, 131; 1931.
[4] Cleghorn, R., *J. Physiol.*, **76**, 193; 1932.
[5] Asher, L., and Klein, O., *Klin. Woch.*, **10**, 1076; 1931.

Natural Melody

ON the evening of October 8, I was at Angmering-on-Sea, and my host, Mr. Kenneth Barnes, called me to listen to the wind playing, and took me to the bathroom, which faced down wind. The wind was blowing hard and gustily, and was producing a most amazing effect—exactly as though a flageolet were being played by a human performer.

The melody was in E. major, with A♯ substituted for A♮, and it ranged over five semitones, of approximate frequency 1290, 1448, 1625, 1824, 1932. The melody did not slur up and down, as when the wind whistles through a cranny, but changed by sharply defined steps from note to note. The melody included runs, slow trills, turns and grace notes, and sounded so artificial that I felt bound to open the window and make sure that the tune was not being played by a human performer out of doors.

The sounds were traced to the overflow pipe of the bath, through which air was rushing in at the rosette (of six holes, each 9 mm. diameter, set in a circle) covering the inner end of the pipe where it joined the bath.

Next morning I examined the pipe. It was about 3 cm. in diameter, and about 3 ft. 5 in. long, in the form of an S-bend, of which the lower portion passed through the outer wall, and ended in an open mouth. The natural frequency of the pipe when blown into by mouth was about 161—that is, three octaves below the keynote of the scale previously indicated. Evidently the wind was playing on the 7th, 8th, 9th, 10th and 11th overtones of the pipe, and the melody was being produced by the rapid fluctuations of wind-pressure.

I wonder whether such an effect can ever have occurred in Nature?—a broken bamboo stem, for example, partially obstructed at its windward end, and so 'shielded' by vegetation, soil, etc., as to produce a pressure difference between its open ends?

The effect of elaborate melodies thus produced without human intervention would be highly magical and suggestive.

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Higher Vibrations of Chladni Plates

THE Chladni plates in use at the present time for producing nodal lines are ordinarily made of brass, ten inches square (or ten inches in diameter if circular) and one eighth or one sixteenth of an inch thick. They are set in vibration by drawing a violin bow along the edge perpendicular to the plate. If the plates are any thinner than one sixteenth of an inch, the pressure of the bow will tend to distort the plate and the resulting figure will be unsymmetrical. Using a slight modification of a valve oscillator described before[1], I have succeeded in getting symmetrical figures upon brass plates one thirty-second and one sixty-fourth of an inch thick. The plate is balanced at the centre upon a small cone attached to the vibrating diaphragm of a loud speaker. A brass plate any thinner than these will bend under its own weight and distort the figure.

The two symmetrical sand figures shown in the illustration (Fig. 1) were produced upon a brass plate

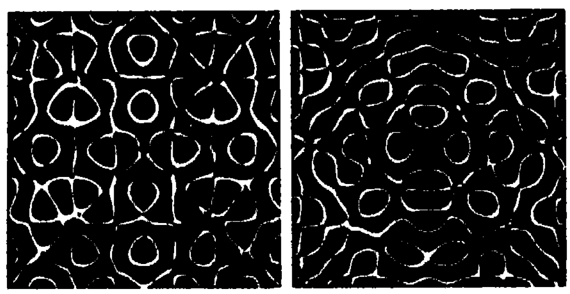

FIG. 1.

one thirty-second of an inch thick. It is possible to obtain hundreds of symmetrical nodal patterns by varying the note of the electric tube. The patterns become more and more complicated as the pitch of the note is raised. These thin plates will break into nodal patterns at very high frequencies.

Prof. Andrade has also invented a vacuum tube oscillator for Chladni plates.[2] He uses a magnetic coupling instead of the mechanical coupling described here.

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[1] *Phil. Mag.*, **12**, Suppl. 320, Aug., 1931.
[2] Andrade and Smith, *Proc. Phys. Soc.*, **43**, 405-411, July, 1931.

Research Items

Medicine Men in Nyasaland.—The Rev. T. Cullen Young describes in *Man* for October the contents of lists of the materia medica of three medicine men, two belonging to the Tumbuka-Kamanga and one to the Tonga tribe of Nyasaland. The material is all written, two-thirds of it by men of education, the 'changing' African. It is to be noted that even in the case of the educated, the spell, which it might have been expected would be eliminated by education, continues to exist side by side with remedies, herbal and other, of a more material nature. The practitioners recognise and treat ordinary disease, such as pneumonia, epilepsy, syphilis, colic, rheumatism, etc., as well as others which we should call extraordinary, such as averting the death of a child if the mother becomes pregnant while nursing, or the evil effects of intercourse with a menstruating woman. The number of ailments or matters treated in the respective lists are 20, 21 and 97, the larger figure in the third list, however, being due to a great extent to method of arrangement. In the last list, also, matters connected with sex, prominent in all, largely preponderate, more than fifty per cent being connected with this subject. Methods in the prescriptions vary widely. Medicines may be taken externally or internally, worn inside the clothing, around the neck, smeared on an inanimate object or concealed in the ground. They may be held beneath the tongue and spat out as certain words are uttered. Sunrise or sunset is the favourable time for taking them. In only one prescription is there any reference to invocation—in connexion with the ceremony of "closing the grave". For a person lying under bewitchment, the remedy is not only applied to the body by rubbing, and worn, but also, when it is no longer required, its ingredients must be bound up in the cloth in which it is worn and "thrown away into running water along with a piece of iron".

Sex Affiliation.—Mr. F. E. Williams, Government anthropologist in the Territory of Papua, discusses in the *Journal of the Royal Anthropological Institute*, vol. 62, pt. 1, a form of social classification by which male children are classified with the father's group and female with the mother's group. At present this classification has been found only among the Koiari-speaking group of the central division; but its distribution may be wider, though this is not at present known. Racially the Koiari, though speaking a Papuan language, are mixed with the Melanesians. The names of the groups are related only to the group and not to villages. Nor are the groups totemic or exogamic. They are best described as local groups, of which the membership is ultimately decided by residence and by participation in group life. Within the family and local group descent is virtually patrilineal. Property is inherited by sons from their fathers. With the female offspring, the position is not so clear. They are brought up by and reside with their fathers, and in some cases are spoken of as belonging to their father's group, while there is evidently a strong tendency to patrilineal descent. Nevertheless they are constantly said to belong to their mother's group; and they inherit their mother's property. The affiliation, however, with the mother's group only holds good for one generation back, and really means that a daughter belongs to her maternal uncle's group. Her mother may belong to quite a different group. If marriage is by purchase the price goes to the father, but is shared with the maternal uncle, unless the *nubagha* (that is, cross-cousin in any degree) has been married, when no purchase price is paid. Exchange and purchase marriage are both practised, though the former is regarded as the ideal. It is possible, therefore, that sex affiliation means that the return of the girl to her mother's group was the normal course when marriage was by exchange with a cross-cousin, and that it still persists, although marriage is no longer restricted by the cross-cousin relation.

Coat Colour and Eye Colour in Rabbits.—Further interesting studies of coat colour and eye colour in rabbits have been made by Prof. W. E. Castle and Dr. Paul B. Sawin (Carnegie Inst. Publ. No. 427). From crosses between the English and Dutch types of colour marking, Castle has produced the French breed known as Blanc de Hötot, which is entirely white, except for a ring of coloured fur around the eyes, and has brown eyes. His experiments indicate that the breed was originally produced from such crosses by a cross-over between the closely linked genes for English and White-Dutch pattern in an individual which was heterozygous for both. It is further concluded that rabbit genetics do not support the conception of step allelomorphism. In the general coat colour series six allelomorphs are now recognised, including three shades of chinchilla. Breeding from blue-eyed chinchillas and various other types it is found that the iris colour and coat colour series are parallel except that the darkest chinchillas have the lightest blue eyes. It is not yet determined whether in dark chinchilla the blue eye is due to the same allelomorph as the coat colour, or to a separate but closely linked gene mutation. The presence of independent modifying genes affecting only iris colour and producing in some cases a 'pseudo-brown' eye is also shown. These experimental results should be of considerable help in the analysis of the inheritance of eye colour in man.

The Primordial Germ-cells of *Sphenodon*.—A contribution to the history of the germ-cells in Reptilia is made by M. Tribe and F. W. Rogers Brambell (*Quart. J. Micr. Sci.*, 75, Pt. II, pp. 251–282, 11 text-figs., 2 pls., 1932) who have examined the embryos of *Sphenodon* collected by the late Prof. Dendy. The primordial germ-cells originate in this animal in the yolk-sac endoderm of the area opaca all round the embryo but chiefly in a crescentic area in front of it. They are recognisable before the differentiation of the medullary plate, being characterised by their large size (as compared with all the other embryonal cells) and by their contained yolk-spherules. These germ-cells migrate through the yolk-sac endoderm and mesoderm, apparently by amoeboid movement, and many of them enter the blood-islands and the sinus terminalis. They enter the embryo either passively in the venous blood-stream or actively by migration through the extra-embryonal endoderm and splanchnic mesoderm into the lateral walls and the mesentery of the mid-gut. The germ-cells in the

vessels penetrate the walls of the latter and migrate, along with those from the lateral walls and mesentery of the mid-gut, to the germinal ridges. Many germ-cells, especially those travelling in the blood stream, are carried to other parts of the embryo and ultimately degenerate and disappear. The primordial germ-cells enter the forming germinal ridges before the single-layered coelomic epithelium covering the latter has begun to proliferate. Having reached this position the germ-cells lose their yolk-spherules and enter on the prophase of the heterotypic division.

A New Family of Coleopterous Insects.—Mr. Charles Oke has described a new family of small beetles from specimens found in nests of an ant at Belgrave, Victoria, where they appear to be living as inquilines (*Proc. Roy. Soc. Victoria*, vol. 44, 1932, pt. 1). The name *Aculagnathus mirabilis* gen. et. sp. nov. is given, while the title of Aculagnathidæ is applied to the new family which they represent. The most peculiar feature respecting these insects is seen in the highly specialised mandibles, each with a long thin process on its outer edge. When the jaw is moved, the process protrudes beyond the labrum, and is evidently used for piercing the prey. The labrum is also in the form of a process, and, with the labium below, forms a kind of open sheath for the processes of the mandibles. The affinities of the family are obscure, but in their tarsal characters they bear resemblance to the Lathridiidæ.

Formation of Dungeness.—The theory that the foreland of Dungeness was formed by the deposition at the meeting of opposing tidal currents has long held sway. Mr. W. V. Lewis has now challenged this tidal current explanation (*Geog. J.*, October) and explains at length his theory of the formation of the headland, based on both historical evidence and observation on the ground. He finds that the last considerable depression of the land in the neighbourhood of Dungeness was the Neolithic depression. At that time there was no headland and the area of Romney Marsh was an inlet of the sea. Mr. Lewis traces the growth of Dungeness to elevation of the land accompanied by the heaping up of shingle ridges by the prevalent south-west waves. He shows how the seaward end of the hard resistant Battle Ridge to the west of Dungeness marks the beginning of these shingle ridges, which formed first in its lee. Each new ridge as elevation continued swung round more to the south to face the waves. From the thirteenth century onwards, depression seems to have set in but so gradually that the ridges were built up as the sea level rose and at the same time driven inland. These are the main points in the explanation, which enters very fully into the history of the various ridges and the shoreline.

Vowels in Italian Words.—When it is recalled that the same phrase spoken by different voices can be clearly distinguished as different, the complexity of even the physical phenomena of speech is not surprising. The necessity for dividing them into the simplest elements is apparent, and since the vowels can be non-transient they have been the first elements of speech to be studied in detail. By the aid of oscillograph and electrical apparatus, studies similar to those made of the vowels of English, American, German and French have been made of Italian vowels by A. Gemelli and G. Pastori in the Psychological Laboratory of the Catholic University of Milan and have recently been reported to the Congress of Psychology at Copenhagen (August, 1932). In addition to the study of single vowels spoken, whispered or sung by various voices either intermittently or continuously, special attention has been given to the modification in a vowel when it forms part of a word or phrase. When a person emits a vowel continuously in a normal tone of voice, oscillograms are obtained in which the same wave-form may be repeated unchanged several hundred times. When the production is intermittent the central part of each vowel record is formed of repetitions of the same characteristic wave-form. When the vowel forms part of a word the oscillogram of the vowel contains a variable number of repetitions of the characteristic wave-form depending on the importance of the vowel in the particular word, together with repetition of a less complex wave-form similar to the same vowel sung. It is suggested that in natural speech the typical wave-form of each vowel is repeated only the smallest number of times necessary for recognition. When all other conditions are unchanged this is found to vary with the same vowel in different words. It is well known that the number of vibrations necessary for the perception of pitch of a pure tone depends on the frequency and the intensity, but it is not easy to apply these results to the recognition of a vowel or other complex sound.

New Experiments on Superconductivity.—McLennan and his co-workers have recently found that the temperature at which superconductivity appears is lower for high-frequency alternating currents than for direct currents. Further experiments on these lines have now been described (*Proc. Roy. Soc.*, October). The substances used were lead, lead-bismuth alloy, tantalum, and tin. The new feature of the present work is the superposition of high frequency and direct currents in the same specimen. A small resonant circuit made entirely of tantalum, or of tin wiped upon constantan wire, was immersed in a helium bath, alternating current of frequency 12×10^6 was induced in the coil and direct current was led in by wires. The resistances to high frequency and direct current disappeared simultaneously at a temperature which lay between the high frequency and direct current critical temperatures. The critical temperature for direct current was thus lowered by the superposition of the high-frequency current, and the critical temperature for high-frequency current was raised by the superposition of direct current.

Settling of Colloidal Suspensions.—The settling of colloidal suspensions under gravity was first studied by Perrin, who obtained a simple logarithmic law for the equilibrium distribution; and his law when modified by a repelling force of van der Waals' type between the particles was in good agreement with later experimental results. More recent work led to the conclusion that the equilibrium concentration became uniform with increasing depth. In the experiments reported by McDowell and Usher (*Proc. Roy. Soc.*, October) the principal feature is a very close temperature control for the avoidance of convection currents. The necessity of this was shown by the fact that the gold sols which had 'settled' in the thermostat became apparently uniform again when removed to an ordinary room.

The experiments indicate that the equilibrium distribution agrees with the simple Perrin law even when the settling layer is 9 mm. deep and the greatest concentration of particles is 10^{12} per c.c.

Mixtures of Ferrous and Manganese Silicates.—A paper by J. H. Andrew and W. R. Maddocks read before the Iron and Steel Institute in September showed that the equilibrium diagrams of the systems $MnSiO_3-Fe_2SiO_4$ and $FeS-Fe_2SiO_4$ are of the eutectiferous type with limited solubility at each end. The melting point of $MnO.SiO_2$ is given as 1305°C. and this substance can hold at the eutectic temperature of around 1170°C. not more than about ten per cent of the iron silicate in solid solution. The eutectic contains about sixty per cent of $2FeO.SiO_2$. From the pure iron silicate to the mixture with ten per cent of the silicate of manganese the melting point appears to rise, but the exact constitution of the mixtures in this range of composition still awaits further elucidation. It is of interest that mixed silicates of the composition referred to have very definite crystallisation temperatures, and do not, as is often assumed, pass through a semi-viscous or plastic state at any stage during the solidification. The $FeS-2FeO.SiO_2$ diagram is also eutectiferous. The eutectic melts at around 1000°C. and contains some fifty per cent of each constituent. The solubility of Fe_2SiO_4 in ferrous sulphide is extremely small, being given as approximately one per cent. About twelve per cent of ferrous sulphide, on the other hand, may dissolve in the silicate. The melting point of the latter is 1130°C., that of ferrous sulphide 1160°C. and of manganese sulphide 1620°C.

Astronomical Topics

Origin of the Solar System.—*Scientia* for September and October contains articles on this subject by Dr. A. C. Gifford of the Dominion Observatory, Wellington, New Zealand. He begins with a résumé of previous work on the subject. In reviewing that of Sir James Jeans, he should have explained that the suggestion that the sun at the time of appulse was highly distended, nearly filling the present orbit of Neptune, was afterwards withdrawn, and replaced by the view that the sun was not much larger than at present, and that the other star approached within the distance of Mercury. There is also an erroneous statement that Jeans dated the approach of the other star as millions of millions of years ago; this should read thousands of millions.

Dr. Gifford is an enthusiastic follower of the late Prof. A. W. Bickerton, who advocated stellar impacts to explain novæ and the birth of planetary systems. Most astronomers consider that such impacts would be far too infrequent to explain novæ, of which some forty or fifty are observed in a century, and probably many faint ones are missed. But this objection is of less weight when the impacts are invoked to explain planetary systems, as these may, for all we know to the contrary, be extremely rare in the universe. Indeed, both Dr. Jeffreys and Prof. Luyten have in recent years adopted the view that the approach of the two stars was so close that their outer portions actually collided. Dr. Gifford prefers to go a stage further, and to assume that the impact was so nearly central that the greater portion of the two stars coalesced to form our present sun, while the tidal filaments raised on both of them would be the origin of the planets. More exact computations are needed than those given in the articles, but some the theory of a nearly full impact seems to have advantages, compared with that of a grazing one.

The Distance of Nova Persei and Nova Ophiuchi.—Dr. Spencer Jones's researches on the distance of Nova Pictoris encouraged him to investigate the two novæ mentioned above. The parallax 0·011″ is often quoted for Nova Persei; this was deduced by assuming that the large expanding nebulosity seen some months after the outburst was due to the spread of illumination from the nova. In the *Observatory* for September Dr. Spencer Jones points out (as Newcomb had done before) that the above parallax involves the assumption that the nebulosity is at the same distance from us as the nova; if the nebulosity is nearer than the nova a smaller parallax results. He deduces a new parallax from the much smaller expanding nebula discovered by Barnard in 1916; this is assumed to be an actual expansion of a shell of gas with a speed (deduced from the spectroscopic measures) of 1110 km./sec. A parallax of 0·00205″ is found, implying a distance five times as great as previously assumed, and an absolute magnitude at maximum of −8·3. A different method was used for Nova Ophiuchi. The interstellar calcium lines in this star gave a velocity differing by 24 km./sec. from that resulting from the usual supposition that this gas is at rest in space. This assumption only holds for regions not very distant from the sun; beyond this region galactic rotation produces a differential velocity. The mean distance of the intervening gas is taken to be half the distance of the nova; a parallax of 0·00029″ results for the latter, so that it is seven times as remote as Nova Persei. This seems to be the most distant nova observed (except those in the spiral nebulæ) and the only one for which this method can be applied. The absolute magnitude at maximum comes out −5·5, which is considered reasonable.

New Minor Planets EA_1 and HA.—E. de la Villemarque, S.J., who has constructed tables for calculating the perturbations of minor planets by Jupiter, has now published (*Astr. Nach.*, No. 5898) coefficients of the perturbation terms in the case of the planet EA_1, now named Amor. It belongs to the same group as the planet Hungaria, so the tables for this group could be utilised; these tables should aid in the recovery of the planet when it again approaches the earth.

A telegram from the I.A.U. Bureau reported the following observation of the planet 1932 *HA* at Königstuhl; Oct. $7^d 2^h 42{\cdot}4^m$ U.T.; R.A. $8^h 22^m 0^s$; N. Decl. 23° 36′, mag. 15·5. Daily motion $+ 1^m 36^s$ 0′ in Decl. The telegram asked for the observation to be controlled, but as the position and motion are close to the predicted values, it seems likely to be right; if so, the observation will be valuable for improving the orbit, as the arc of observation in April and May was too short to give very exact elements; the brightness should remain nearly constant for some time, as the planet though receding from the sun is approaching the earth.

Fourteenth International Physiological Congress

THE members of the Fourteenth International Physiological Congress assembled at Rome on August 29 in circumstances embarrassing to the law-abiding scientific worker. The approaches to the Campidoglio, where the inaugural session was to take place, proved to be guarded by several cordons of police. After passing a close inspection by a civilian official and, at the doors of the Sala di Giulio Cesare, a final check by two imposing flunkeys, those delegates who had not forgotten their cards of membership were able to hear speeches of welcome by the Governor of Rome, the Minister of Education, and others. An inaugural address by Prof. A. V. Hill should have closed the proceedings, but the Congress was unexpectedly honoured by the appearance of Signor Mussolini, who, in a few graceful phrases, extended to the Congress the welcome of his Government.

Prof. Hill, relying on the existence of advance printed copies of his address, earned the gratitude and admiration of many by curtailing severely the academic sections of his speech; bringing incidentally into deservedly greater prominence some timely comments on the "intolerable burden of the literature" under which physiologists, no less than other scientific workers, sweat and groan. "The days are already too short, to read all that appears in print." With bluntness tempered by his usual good humour, he discussed the unnecessary multiplication of papers and pointed to the two major causes of the nuisance —self-advertisement by younger men, whose advancement depends all too often on the weight of paper they have sullied with printer's ink; and, in some countries, profit-making by publishers and owners of scientific journals. All journals should be owned and controlled, he insisted, by scientific societies, and he recommended that the Congress should appoint an international committee forthwith to consider the publication and cataloguing of physiological and biochemical papers. Not only in writing about our work, but also in speaking about it, he further insisted, we too often waste our opportunities and the time of our colleagues at scientific meetings. "There is no excuse for telling busy people in fifteen minutes what they could perfectly well read in five. . . ."

The inaugural meeting finished before lunch, and the remainder of the day was spent in visiting the excavations at Ostia and bathing at the famous Ostia Lido; the serious work of the Congress began on Tuesday, when four parallel sections were held morning and afternoon, each session being composed of six to twelve papers having some central theme in common. A reception offered by His Highness the Governor of Rome at the Palazzo dei Conservatori concluded the activities of the second day. On Wednesday, in addition to the morning and afternoon sessions devoted to the presentation of original papers, Prof. P. Karrer delivered an address to the Congress entitled "Uber Carotinoide und Vitamin A"; and the evening was the occasion of a banquet given by the organising committee of the Congress at the Hotel Excelsior. At the banquet, consisting mainly of Italian dishes, excellently served, and admirably adapted to the heat of the evening, speeches were made by prominent physiologists from all parts of the world, congratulating the Organising Committee on the excellence of its arrangements.

Thursday was a holiday from all scientific discussion and the Congress journeyed to Tivoli, where it spent a peaceful day in the delightful parks of the Villa Adriana and the Villa D'Este. The Friday afternoon sessions were preceded by a lecture given by Prof. I. P. Pavlov on the more recent work of his school ("La Physiologie de l'activité nerveuse supérieure"). He spoke in German to a large and deeply interested audience.

On Saturday morning a party of members of the Congress was received in audience by the Pope, and, in the afternoon, the concluding session was held in the Royal Academy of the Lincei. After a short speech of welcome by the president of the Congress (Prof. Bottazzi), Profs. Barger and Mansfeld (the former in Italian, to the envy of his colleagues, and the amazement of those who were unaware of his linguistic reserves) conveyed the thanks of the members of the Congress to Prof. Bottazzi and the Italian Organising Committee, and the appreciation of the magnitude of their task. Prof. Pavlov, in the name of the Russian physiologists, then invited the International Physiological Congress to hold its fifteenth meeting in Russia: this invitation was accepted with acclamation. Prof. Frank then proposed that the succeeding Congress, in 1938, should be held in Germany: this also was agreed to. Members of the Congress then visited the picture galleries until it was time to cross the road to the Farnesina Palace, where the Royal Academy of Italy held a reception. In the absence of the president, Senator Marconi, the vice-president received the guests.

On Sunday, a party left for a three days' visit to Naples, and its Marine Biological Station. Excursions were arranged for those who were unable to take part, but wished to remain in Rome another day.

Any detailed description of the subject matter of the four hundred papers communicated to the Congress would be out of place here, and is rendered unnecessary by the publication of the *Proceedings* in book form by the Organising Committee. Some notion of the activity of physiologists in different fields during the past three years may be obtained from the following summary of the subject matter of each of the thirty-one sessions of the Congress.

2 Sessions each:	Circulation, muscle, central nervous system.
1½ Sessions each:	Carbohydrate metabolism, general chemistry, internal secretions, vitamins, physical chemistry.
1 Session each:	Respiration, enzymes, fat metabolism, general metabolism, nerve, blood, digestion, pharmacology, special senses, reproduction, plants and bacteria, cellular physiology.
½ Session each:	Kidney, immunity.

(4 Sessions unclassified. Two half-sessions counted as one session throughout.)

An analysis of the nature of the communications reveals two interesting characteristics: the relative predominance of work of a chemical or physical nature, and the absence of any advance of a notable

kind in any quarter. Consequently, if we are to mention any particular paper rather than any other, the choice must, of necessity, be made more or less at random, and be influenced as much by our own personal interests, as by the intrinsic merit of the work itself. Indeed, the great difficulty that we found in preparing a review of the scientific proceedings which should be of interest to physiologists in general—we very early abandoned the attempt to make it of interest to workers in other branches of science—has convinced us that the wrong type of paper was presented. An international congress, meeting triennially, besides giving opportunity for personal contacts and private discussion—as was emphasised by Prof. A. V. Hill, in his opening address—should consist mainly, if not entirely, of reviews of the progress made in the last three years. These should be of interest to workers in all branches of physiology. Such a limitation in scope would do much to relieve the present congestion of space-time.

A number of new technical methods have been introduced since the last Congress. In the realm of cellular physiology there is the centrifuge-microscope of Newton Harvey (Princeton), with which he has been able to measure the interfacial tension at the surface of living organisms by observing a cell being pulled into two parts by a known centrifugal force after injecting a drop of oil. Then, in the realm of muscle physiology, there is the method of von Muralt (Heidelberg) for observing the changes in the anisotropic properties of striated muscle during a single twitch by recording the Fizeau-Foucault bands: further developments of this technique will be awaited with great interest. Lastly, in the realm of cardiology, there is the di-electrograph of Atzler and Lehmann (Dortmund). This is an instrument for recording the output of the heart in human subjects. Two plates are placed, one on the subject's chest and the other on his back; they thus act as a parallel plate condenser and the capacity between them is greater at the end of diastole, when the heart is full of blood, than it is at the end of systole. These changes in capacity are arranged to affect the frequency of an oscillating circuit, and the changes in frequency are recorded as deflections of an oscillograph after suitable detection and amplification. No suggestion is made that the records are quantitative, since much of the blood expelled at each systole is retained in the pulmonary circulation, but the shape of the di-electrograph record appears to be constant for any given subject under given conditions, and it seems probable that variations in this shape may have diagnostic significance.

The number of communications concerned with muscle physiology reflected the unusual activity which has characterised this field of work during the last few years. E. Lundsgaard (Copenhagen) reported the results of a more exact study of the phosphagen breakdown during activity of muscles poisoned with iodoacetic acid. The strict proportionality between phosphagen breakdown and energy released in a series of isometric twitches (ΣTl) earlier reported by him, is confirmed in all cases where the muscle is not too severely fatigued. The energy released never exceeds that which would be derived from the chemical reaction in question. In later stages of fatigue, extra energy is released and this has now been traced by Lundsgaard to the hydrolysis of adenylpyrophosphoric acid.

F. O. Schmidt (St. Louis) reported measurements on the effect of stimulation on the oxygen consumption of nerve, leading to the important result that stimuli too small to produce an action current also fail to produce an increase of oxygen consumption. A neat demonstration of this was achieved by choosing stimuli within the range of magnitude over which reversal of the direction of the current affects considerably the magnitude of the action current induced. The extra oxygen consumption was found to be proportional to the action current.

Kato and his co-workers (Tokyo) reported their successful isolation of single nerve fibres from a nerve trunk such as the peroneal or sciatic, and their observation that the effect of stimulation depends upon the size of the fibre. The contractions of muscle fibres innervated by such a fibre obey the all-or-none relation.

The study of 'chronaxie' continues steadily. Lapicque (Paris) read a paper introducing the term 'metachronosis' to indicate the changes in the time relations of excitable tissues in the same way that metamorphosis indicates the changes in their anatomical form. Such metachronosis may be due to toxic agents, such as curare; or it may be physiological, for example, as a result of iterative stimulation of the sympathetic system. Such metachronoses have recently been the chief study of Lapicque's disciples. This paper provoked Rushton to remind us that many workers (notably Keith Lucas) have failed to observe any metachronosis as a result of curarisation, and that one of the most certain ways of changing the apparent time relations of an excitable tissue is to change the size and disposition of the stimulating electrodes.

Representing the physiology of the circulation and respiration, we may instance the communications of Anrep and his co-workers (Cairo), who reported the results of their investigations on the respiratory variations in the heart frequency, using innervated heart-lung and similar preparations. They have come to the conclusion that these variations have both a central and a reflex origin, and their papers were followed by a discussion, which was all the more welcome in comparison with the apathy of the audience on most occasions, and in which Prof. Hering (Cologne) took a prominent part.

Among the more interesting contributions in the field of metabolism were three from R. A. Peters and his school (Oxford) on the nature of the function of vitamin B in nervous tissue. Different parts of the brains of pigeons were minced and incubated in phosphate buffer at *p*H 7·4, and the rate of oxygen consumption measured. In the absence of added substrate, or if the substrate were succinic acid, no significant difference could be observed between the oxygen consumption rate of the tissues of normal and of avitaminous birds. The ability of the tissue to oxidise added glucose was, however, markedly less in the case of avitaminous birds and the difference was even more apparent when lactate was the added substrate. The pathological tissue had in this case only 60–70 per cent of the respiration rate of the normal. Not all parts of the brain appeared to be affected: the optic lobes gave the most striking results, whilst cerebellar tissue seemed to be unaffected. That the effect is directly related to the vitamin deficiency and is not merely the result of a lowered vitality, was clearly demonstrated by the observation that within 24 hours of the administration of a curative dose of vitamin B_1 concentrate to birds showing serious polyneuritic symptoms, the tissues in question proved to be normal once more.

Of similar significance is the demonstration that the administration of the concentrate to the minced tissue *in vitro* abolishes at once the difference between the avitaminous and the normal tissue.

H. E. Himwich and others (New Haven) contributed the results of a careful study of alcohol metabolism in dogs and men. Clear evidence has been obtained of a state of acidosis during the twenty-four hours following the oral administration of ethyl alcohol equivalent in amount to eight 'double whiskies'. The bearing of this finding on the measurement of the respiratory quotients of human subjects needs no emphasis.

In the physiology of digestion, mention may be made of the accounts given by Soula and co-workers (Toulouse) on the relation between the blood sugar concentration and the secretion of the digestive juices, and of the studies on the effect of fat on gastric secretion and motility by Lim (Peiping) and Ivy and Zettelman (Chicago).

L. E. BAYLISS.
P. EGGLETON.

Co-operation in Electrical Standards

A FACTOR which has greatly facilitated the rapid development of the electrical industry throughout the world is the close agreement which exists in practically all countries as to the units in terms of which the various electrical quantities are measured. The international adoption of the units of current and voltage, for example, has been a great help to international trade. It is a pity that a similar simplification has not been introduced into the various national units of length, mass and money. Luckily, the agreement in electrical matters is based upon measurements of the highest precision made in the leading laboratories of the world. The close co-operation which exists between the scientific workers and standardising institutions of all nations has made this possible. A brochure recently published from the National Physical Laboratory (H.M. Stationery Office, 2s.), containing Papers 2 and 3 of its "Collected Researches", vol. 24, is an admirable illustration of this co-operation. Part 2 gives the intercomparison of the capacitance (capacity) and power factor of a mica capacitor (condenser). The tests were made by H. L. Curtis and C. Matilda Sparks of the Bureau of Standards and Dr. L. Hartshorn and N. F. Astbury of the National Physical Laboratory. Part 3 gives an international determination of the electromotive force of the normal Weston cell by P. Vigoureux of the National Physical Laboratory.

A mica condenser was transported on four occasions between the U.S. Bureau of Standards and the National Physical Laboratory. Seven sets of measurements were taken. During the first transportation a change occurred in the capacitance but no subsequent changes were observed. The change in capacitance of a mica condenser with barometric height is normally about 0·2 parts in ten thousand. The differences in the barometric pressure due to the relative altitudes of the two laboratories and ordinary atmospheric variations probably produced a change of less than one part in ten thousand. When due allowance was made, the measurements carried out in the two countries agreed to about the hundredth part of one per cent. This is quite satisfactory seeing that the methods of measurement adopted by the two laboratories were quite different.

Mr. Vigoureux's paper gives an account of new determinations of the international units of current and voltage which were made in Berlin in the summer of 1931 by members of the staffs of the National Physical Laboratory, the U.S. Bureau of Standards, Washington, and the Physikalisch-Technische Reichsanstalt, Germany. The measurements were made by weighing the amount of silver deposited when the current flows through a solution of silver nitrate. In the experiments described the same current was passed in succession through the apparatus belonging to the three national representatives, who each made weighings of the silver deposited. The mean results of a number of experiments agreed to about one five-hundredth part of one per cent. Standard cells used at the various laboratories as standards of voltage were measured in terms of the current so determined, and certain small discrepancies which had been suspected between measurements made in the different countries were accounted for satisfactorily.

Building Research*

MANY developments in the work of the Research Station near Watford are described in the Report of the year's work of the Building Research Board recently published, and in spite of necessary economies evidence of useful activities for the improvement of materials and construction are no less apparent than in former years.

The cost of building is influenced by the regulations enforced in connexion with construction, and the modification of these regulations so far as London is concerned has called upon the work of the Station. At the request of the London County Council, a committee has been set up to review the present methods and regulations for the use of reinforced concrete and a considerable part has been taken in the work of the Steel Structures Research Committee, resulting in revised regulations by the Council on the subject of steel-framed buildings which should appreciably assist the steel industry and help to reduce building costs.

Tests on building materials are naturally a large item in the list of the researches undertaken by the Station and the increasing number of requests for such tests from outside has made some definite policy on this matter imperative. It has been decided to enlist the services of approved firms of testing engineers and institutions in carrying out this work under the supervision of the Station rather than incur large capital outlay, and this effort to reduce overlapping and utilise existing agencies is to be commended. The tests thus made will be to the approval of the Station, which will issue certificates upon them.

* Department of Scientific and Industrial Research. Report of the Building Research Board, with the Report of the Director of Building Research, for the year 1931. Pp. ix+158. (London: H.M. Stationery Office, 1932). 3s. net.

The London County Council has approached the Building Research Station on the subject of fire risks, and the testing of materials for fire resistance, necessarily a matter involving considerable capital cost, is being debated with firms interested in the production of such materials. For experiments on the heating of buildings it is proposed to construct a special house where walls, floors and ceilings would be capable of thermal control, while for the prediction of sunlight obtainable by any room in a proposed house a simple instrument, the 'helidon', has been designed. The difficult problem of excluding damp from dwellings has been further investigated, and it would appear that a large number of specifics for treating walls to prevent the entrance of moisture are of very small value. Much remains to be done on this subject, but it seems likely that some means of allowing moisture to evaporate externally is more promising as a solution than attempts to render walls wholly impervious.

In connexion with the weathering of stones, the work of the Station on the selection of stone for repairs to the Houses of Parliament will be remembered, and now a survey of building stone resources is being undertaken in collaboration with H.M. Geological Survey, nearly 150 samples of Portland stone having been examined during the past year. The selection of suitable stone for building has, as is too well known from examples of decay, a very marked bearing on the ultimate cost of upkeep, and as this decay is due to many diverse agencies which operate very unequally in different localities, the acquisition of adequate knowledge requires prolonged investigation.

This survey by no means exhausts the account of the work done during the year by the Building Research Board, as indicated in the 150 pages of the Report, but is sufficient to show the contribution which the Research Station is making to bring the appreciation of the fruits of science home to the architect and industrialist and to indicate how such knowledge can be turned to practical account.

Physics in Meteorology

THE eighteenth lecture of the "Physics in Industry" series founded by the Institute of Physics was delivered on November 2 by Dr. G. C. Simpson, Director of the Meteorological Office, who took as his subject "Physics in Meteorology." Dr. Simpson said that meteorology is mainly applied physics; every branch of physics finds an application in it and he described five recent meteorological investigations which have respectively depended on an application of sound, light, heat, magnetism and electricity.

When large and violent explosions occurred it was noticed that the sound was loudest near the origin and then decreased, as one would expect, until at a certain distance, about sixty miles, it could no longer be heard. The surprising observation, however, was made that at still greater distances, more than 120 miles, the sound was again audible. After the War, much work was done to try to find an explanation of this curious effect. In Great Britain, Dr. F. J. W. Whipple of Kew Observatory organised an investigation and records were obtained at Sheffield, Birmingham, Bristol, Nottingham and Cardiff of the sounds made when large guns were fired in Shoeburyness, near the mouth of the Thames. The result of this work has shown that the old idea that the upper atmosphere—the stratosphere—is cold throughout, can no longer be held. The stratosphere is cold up to a height of about 25 miles and then it becomes warm again and at great heights becomes even warmer than at the surface.

The theory of optics has been used very much in meteorology especially to determine whether clouds are composed of water or ice, but recently spectroscopy has been used by Dr. G. M. B. Dobson, of Oxford, to investigate the amount of ozone present in the upper atmosphere. He finds that, while there is practically no ozone lower than 30 miles above the surface, at greater heights there is a relatively large quantity and it is the presence of this ozone which makes the upper atmosphere warm. A very unexpected result has come out of this work, for Dr. Dobson shows that the ozone is not uniformly distributed, but is concentrated in the neighbourhood of cyclonic depressions and is relatively weak in the neighbourhood of anticyclones. How cyclones and anticyclones, which are known to be phenomena of the lower atmosphere, can effect the amount of ozone 30 miles up in the atmosphere, or whether it is the other way about and the ozone causes the cyclones, are problems which cannot yet be solved.

For his example of the application of the physics of heat to meteorology, Dr. Simpson described some of his own work on the balance of incoming and outgoing radiation. Heat reaches the earth as short-wave radiation from the sun and leaves again as long-wave radiation from the upper atmosphere. The incoming radiation is much greater in equatorial than in polar regions, thus accounting for the difference of temperature between the equator and the poles. Calculations, however, show that the outgoing radiation is practically the same from all parts of the earth, and the poles send as much radiation into outer space as do the equatorial regions. As the polar regions send out much more heat than they receive from the sun, the loss has to be made up by transfer of heat from low to high latitudes. It is the transfer of this heat which is the driving force of the winds.

Magnetism has not much direct effect on the atmosphere and, therefore, does not enter much into meteorology: but in most countries the study of the natural magnetism of the earth—terrestrial magnetism—is part of the duty of meteorologists, and in Great Britain two of the chief observatories where terrestrial magnetism is studied are under the control of the Meteorological Office. Terrestrial magnetism is known to be greatly affected by the activity of the sun and so is the atmosphere, but it has always been difficult to find any relationship between terrestrial magnetism and the atmosphere. Recently, however, Mr. J. M. Stagg, who is at present in charge of the British Polar Year Expedition to Fort Rae in Canada, has found an interesting relationship at Aberdeen between magnetic activity and the barometric pressure. This relationship, however, must be examined further before it can be shown to be real.

Electricity, unlike magnetism, plays an important part in meteorology, especially in thunderstorms. Dr. Simpson, however, discussed another aspect of

atmospheric electricity and described the electrical field which always exists even in fine weather near the earth's surface. He said that this field is probably due to the fact that the conducting layers in the upper atmosphere, the so-called Kennelly-Heaviside and Appleton layers, are maintained at a potential of several million volts above ground potential. How the difference of potential is maintained is one of the main problems of atmospheric electricity. Prof. C. T. R. Wilson considers that thunderstorms are the cause, while others consider that some solar effect is responsible because the potential is highest each day when the earth's north magnetic pole points most directly towards the sun. In conclusion, Dr. Simpson described some recent experiments at Kew Observatory which indicate that the ionisation of the lower atmosphere is not uniform, but that the ions occur in parcels. This observation is likely to have an important bearing on the theory of the ionisation of the atmosphere.

University and Educational Intelligence

BRISTOL.—Mr. N. F. Mott, lecturer in mathematics in the University of Cambridge, has been elected to the Melville Wills chair of theoretical physics in the University of Bristol in succession to Prof. J. E. Lennard-Jones. By agreement with the University of Cambridge, Prof. Lennard-Jones will give assistance to the Wills Laboratory during the present session and Mr. Mott will not take up his duties until next autumn.

Dr. C. M. Yonge, of the Marine Biological Laboratory, Plymouth, has been appointed to the chair of zoology in the University.

CAMBRIDGE.—Dr. Drury has been appointed Huddersfield lecturer in special pathology. J. S. Turner, of Selwyn College, has been appointed to the Frank Smart University studentship in botany.

Sir James Jeans will deliver the Henry Sidgwick memorial lecture on November 26 at 5 P.M. in the College Hall, Newnham College. The subject of the lecture is "The Furthest Depths of Space".

LONDON.—In consequence of the announcement that Major the Hon. John J. Astor, M.P., was the anonymous donor in 1920 of the gift of £20,000 for the endowment of the University chair of physiology at the Middlesex Hospital Medical School, it has been decided that the title of this chair shall now be the "John Astor Chair of Physiology tenable at the Middlesex Hospital Medical School". As recently announced, a gift of £1,500 a year for seven years has been promised by the Prudential Assurance Company for the endowment of the chair of public health tenable at the London School of Hygiene and Tropical Medicine; it has been decided that the chair shall be known as the "Prudential Chair of Public Health" for the duration of the gift.

The title of emeritus professor of mathematics in the University has been conferred on Prof. S. A. F. White, on his retirement from the chair of mathematics at King's College.

MANCHESTER.—Dr. John Hollingworth has been appointed to succeed Prof. Miles Walker, who has held the chair of electrical engineering in the University and College of Technology since 1912. Prof. Miles Walker's many services to electrical engineering are well known; in Manchester he will be remembered for the close association of the engineering industry and the University which he has been instrumental in bringing about. Dr. Hollingworth was educated at Bradfield College, University College (London), Peterhouse (Cambridge) and the City and Guilds Engineering College. He was a wrangler at Cambridge in 1907, and has since held various appointments both industrial and academic. Prior to 1917 his experience was all in heavy engineering; since that date he has been engaged in radio research.

The following appointments have also been made: Demonstrator in anatomy, Mr. A. N. Birkett; demonstrators in pharmaceutics, Dr. Kenneth Bullock and Mr. S. L. Prescott; lecturer in mathematics (College of Technology), Mr. James Topping; assistant lecturer in metallurgy and assaying (College of Technology), Mr. E. A. Fowler; demonstrator in physics (College of Technology), Mr. Joseph Bor.

Mr. C. J. P. D. La Touche has resigned his post as research assistant in mycology on his appointment as lecturer in botany in University College, Dublin.

The Council has accepted from Mrs. R. W. Williamson a portrait in oils of her father-in-law, the late Prof. W. C. Williamson, who was in charge of the teaching of zoology, botany and geology in Owens College from 1851 until 1892.

THE thirty-third annual meeting of the Science Masters' Association will be held at the University of Bristol on January 3–6, 1933, under the presidency of Prof. A. M. Tyndall, who will deliver an address on "Gaseous Ions". Several lectures have also been arranged to be given by members of the staff of the University. Further information can be obtained from the Annual Meeting Secretary, Shirley Hill, Boden Road, Hall Green, Birmingham.

Calendar of Geographical Exploration

Nov. 8, 1903.—An Antarctic Rescue

Capt. Irizar rescued Otto Nordenskiöld and his party. Dr. O. Nordenskiöld, nephew of the hero of the *Vega* expedition, with C. A. Larsen and J. Gunnar Andersson, left Göteborg on October 16, 1901, for research work in the antarctic. His vessel was off the South Shetlands in 1902 and proceeded down the west coast of Louis Philippe Land, discovering that the Orleans channel did not reach Weddell Sea, but was merely a part of Gerlache Strait. On February 12 Nordenskiöld, three scientific workers and two sailors, landed on Snow Hill Island in 64° 25′ S. and established winter quarters. The ship went north to carry on researches in the open sea. She did not return in spring as expected and the party was compelled to spend a second winter, during which the insularity of Ross Island was established. In October, 1903, Nordenskiöld encountered Andersson and a companion, black from head to foot and with long black hair and bushy beards, so that they were at first not recognisable. They had left the ship when it became clear that she could not reach the winter camp and had set out on foot, eking out their scanty diet with seal oil. On November 8, Capt. Irizar of the Argentine naval vessel, *Uruguay*, reached Snow Hill Island and, that night, by an extraordinary coincidence, Larsen and the crew also arrived. The ship had been caught in the ice in Erebus and Terror Gulf in January and so

damaged that she sank; the crew had wintered on Paulet Island. Capt. Irizar's timely arrival thus saved the whole party.

Nov. 10, 1898.—Sir Charles Hose in Sarawak

Sir Charles Hose, with Drs. McDougall and C. S. Myers, set out for the hitherto unexplored regions between the headwaters of the Batang-Kayan, Rijang and Baram Rivers in the Madang territory of Borneo. Between 1884 and 1892, Hose explored most of northern Sarawak and opened up much previously unvisited country in the valley of the Baram River.

Nov. 12, 1799.—Alexander von Humboldt

On the night of November 12–13, Alexander von Humboldt observed in Cumana, Venezuela, that meteor shower which forms the starting point of our knowledge of the periodicity of the phenomenon. Humboldt and A. Bonpland, the botanist, had sailed from Corunna in 1799, stopped at Teneriffe and ascended the peak, and thence proceeded to Cumana. From Cumana they went to Caracas and in 1800 Humboldt left that town to explore the Orinoco River. He covered 1725 miles of wild and uninhabited country and confirmed the fact that the Cassiquiari links the Amazon to the Orinoco. Teixeira had been told of the probability of this when he explored the Amazon in 1637–39, but the statement was received with incredulity. On November 24, 1800, Humboldt and Bonpland went to Cuba and, after a stay of some months, recrossed to Cartagena. They ascended the Magdalena, crossed the Cordilleras and reached Quito on January 6, 1802. They climbed Pichincha and Chimborazo and made an expedition to the sources of the Amazon. At Callao, Humboldt observed the transit of Mercury. Humboldt contributed much to the purely exploratory side of geography, but his more important work was the laying of the foundation of the broad outlines of physical geography and meteorology. He discovered the decrease in intensity of the earth's magnetic force towards the equator; he worked out a formula relating decrease in temperature to elevation above sea level; he introduced the idea of isothermal lines. He was also interested in the relation between plant and animal life and its environment. Humboldt's example was a powerful stimulus to the development of the scientific side of subsequent explorations.

Nov. 12, 1882.—Kishen Singh's Famous Journey

"A–K", Kishen Singh, arrived at Darjeeling after the last and most remarkable of his memorable explorations. He set out from Darjeeling in 1878, reached Lhasa, travelled across Tibet, crossed the Altyn Tagh and reached Sa-Chow, his northern limit. He then crossed eastern Tibet, entered China and journeyed through Batang. He could not get a passage to Assam, so he turned northwards and made a great bend round the Brahmaputra River, which he ultimately touched at Tsetang. This magnificent feat included the crossing of a vast area of entirely unknown country, from which he brought back details of atmospheric conditions, population and trade possibilities. His survey suggested the belief, confirmed later by the travels of Kinthup, a native of Sikkim, that the Brahmaputra, the Dihang and the Tsang-po were all one river. In a previous journey in 1871, Kishen Singh had solved the geography of the region between Shigatse and the great lake Tengri Nor, north of Lhasa, and had thoroughly explored a northern tributary of the Brahmaputra.

Societies and Academies

CAPE TOWN

Royal Society of South Africa, Aug. 17.—E. Newbery: Electrolytic rectifiers. The theory that the behaviour of a valve electrode can be accounted for by assuming the formation of a semi-permeable membrane on the surface is fully justified by further investigation with the aid of the cathode ray oscillograph. A valve electrode is capable of rectifying an alternating current only when the anodic membrane is not reducible by atomic hydrogen, and further, in the case of aluminium, the membrane consists of the oxide only and not the hydroxide.—G. M. Dreosti: A method of measuring the pressures on oranges *during and after the process of packing*. The pressure upon an orange has been found to vary with the details of packing. A few measurements of the change of pressure with time in a cold store indicate that the pressure falls roughly 0·35 per cent an hour during the first hundred hours. Making a few assumptions, simple formulæ have been set up for the derivation of the forces between two oranges in contact and between an orange and the faces of the box with which it is in contact.—F. G. Cawston: Native medicines in Natal. An account is given of investigations into South African native and Indian herbal remedies used and sold in Natal for medical purposes.—Sir Thomas Muir: Note on a set of equivalent determinants connected with a 3-by-6 array.—I. Schrire and H. Zwarenstein: Protein metabolism and the effects of injection of testicular extracts on castrated animals. It has previously been shown that after castration there is a marked increase in creatinine excretion in male rabbits. Following the injection of testicular extracts into castrated animals, there is a drop in the high creatinine excretion to pre-castration levels. This drop is only transient, and in a day or two after the injection, the creatinine excretion is once more at the normal castration level.

ROME

Royal National Academy of the Lincei, May 15.—V. Nobile: Laws of central force corresponding with fixed trajectories, and a noteworthy particular case. The problem considered, which is a particular case of that stated and resolved by Sakellariou (1929), is as follows: Given a family of curves by means of a polar equation containing k parameters, $f(r,\theta : a_1 a_2 \ldots a_k) = 0$, to determine the most general law of central force (with intensity a function of the point and vector velocity) with which the given lines correspond as trajectories.—A. Sommerfeld: Asymptotic integration of the Thomas-Fermi differential equation.—Giacinta Andruetto: The Saint-Venant formulæ for the varieties V_n with constant curvature. The simple procedure recently given for obtaining the Saint-Venant formulæ for any variety with three dimensions is now extended to the case of a variety V_n with n dimensions, supposing a constant Riemannian curvature.—A de Mira Fernandes: The unitary theory of physical space.—A. Kolmogoroff: The general form of a homogeneous 'stocastic' process (a problem of Bruno de Finetti).—B. Manià: A theorem of existence in the calculus of variations.—M. L. Dubreil-Jacotin: Waves of permanent type in heterogeneous liquids. Various rigorous properties of these waves are established for the case in which the movement is the same in parallel vertical planes,

so that it may be studied in one of these planes as a two-dimensional movement.—Z. Pycha: Relativity in the microcosm.—A. Desio: Presence of the Eocene in Eastern Fezzan (Tripoli).—Silvia Colla: Investigations on the movement of the stamens in certain Berberidaceæ. Action of multiple subliminal stimuli of low frequency.—Z. Danin: Investigations on the gaseous content of certain Algæ. The gases contained in *Enteromorpha compressa* Ag.

SYDNEY

Linnean Society of New South Wales, July 27.—C. Deane: Trichopterygidæ of Australia and adjacent islands. Descriptions of two new genera and eighteen new species. A key to genera dealt with by the author in this and the two previous papers is also given with a table showing the numbers of known species from various parts of the world.—F. A. Craft: The physiography of the Shoalhaven River valley. (5) The upper valley and the stream system. Two peneplain levels are recognised towards the head of the Shoalhaven—one of a composite nature with its principal development between 2400 ft. and 2600 ft., in which was developed the Shoalhaven Plain farther to the north at a slightly lower level, and an older feature which rises from 3000 ft. in the middle valley to 4000 ft. at the head of the river. The stream system appears to have developed on this older surface, although some variation has taken place as a result of limited captures by streams cutting back from the south-east along lines of weakness.—A. Burges: Notes on the mosses of New South Wales. (1) Additional records and description of a new species of *Buxbaumia*. This is the first paper of a series intended to bring up to date the census of New South Wales mosses published by Watts and Whitelegge in 1902 and 1905. A list is given of records in the subclass Bryales, order group Eubryinales, and a new species of *Buxbaumia* is described from the Williams River, N.S.W.—G. A. Waterhouse: Australian Hesperiidae. (2) Notes and descriptions of new forms. Two new species and fifteen new subspecies are described. In addition, one new species is recorded from Australia for the first time. It is shown that in the Australian region many of the genera of the subfamily Pamphilinæ have pairs of closely related species. Notes are given on a number of subspecies, showing their relationship to the typical species found in the oriental region.

Aug. 31.—J. R. Malloch: Notes on Australian Diptera (32). Three new species are described and a key is given for the species of the genus *Fergusonina*, family Agromyzidæ. A new genus and species of the family Ochthiphilidæ are also described. All the species described as new are probably of economic importance.—F. A. Craft: The physiography of the Shoalhaven River valley. (6) Conclusion. The master peneplanation recorded in the area preceded the deposition of the Permian Upper Marine series, and later gentle uplift at intervals has allowed the invasion of the elevated plateau mass by streams, which have carved a series of terraces on a large scale, finally giving the incomplete peneplain which comprises a great part of the area, and has extensive deposits of Tertiary drift and basalt on its surface. The original divides were aligned east and west, and streams flowed from them to ancient depressions; there was a tendency towards capture from the eastern coast as the various uplifts took place.—F. A. Craft: Notes on erosional processes and stream gravels. Negative forms in granite areas are correlated with well-developed stream systems. The widening of valleys in the horizontal rocks of the Blue Mountain plateau are dealt with; the conditions of formation of ellipsoidal and flattened stream gravels in terms of stream power and motion and the climate indicated by Tertiary drifts of the Shoalhaven Valley are described.—A. Jefferis Turner: Revision of Australian Lepidoptera. Oecophoridæ (1). A key is given for indentification of the twenty-four genera. This part deals with sixteen genera, and includes descriptions of three genera and thirty species as new.

Forthcoming Events

MONDAY, Nov. 7

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY—(at the London School of Economics and Political Science).—Dr. George H. Miles: "The Human Factor in the Marketing and Distribution of Goods", at 6 P.M. (succeeding lectures on Nov. 14 and 21).

ROYAL INSTITUTE OF BRITISH ARCHITECTS—(Inaugural Meeting).—Presidential Address, at 9 P.M.

TUESDAY, Nov. 8

KING'S COLLEGE, LONDON.—F. H. Preece: "Boiler House Economics", at 5.30 P.M.

ILLUMINATING ENGINEERING SOCIETY—(at the Laboratories of the General Electric Co., Ltd., Wembley).—C. C. Paterson: "Luminous Discharge Tube Lighting", at 7 P.M.

ROYAL ANTHROPOLOGICAL INSTITUTE—(at the School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Maj. P. H. G. Powell-Cotton: "Benin Brass Casting and Handicrafts in the Cameroons", at 8.30 P.M.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN.—C. H. Hampshire: "The British Pharmacopœia, 1932", at 8.30 P.M.

ROYAL INSTITUTION.—Prof. E. N. da C. Andrade: "Rays and Radiations", at 5.15 P.M. (succeeding lectures on Nov. 15 and 22).

WEDNESDAY, Nov. 9

ROYAL SOCIETY OF ARTS.—T. Thorne Baker: "New Developments in Colour Cinematography", at 8 P.M.

THURSDAY, Nov. 10

KING'S COLLEGE, LONDON.—Dr. J. A. Hewitt: "The Influence of Ductless Glands on Metabolism", at 5 P.M. (succeeding lectures on Nov. 17, 24 and Dec. 1).

Official Publications Received

GREAT BRITAIN AND IRELAND

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), Nos. 21-27: Report of the Irish Radium Committee for the Year 1931 (including Reports by Oliver Chance, John A. Geraghty, Oswald J. Murphy, C. Conor O'Malley, Dr. Bethel Solomons, Sir Robert Woods); The Inhibition of Chemical Reactions, Part 5: The Influence of Pyridine and other Substances on the Absorption of Ethylene by Sulphuric Acid, and on the Surface Tension of Sulphuric Acid, by William Sydney Eagar Hickson and Dr. Kenneth Claude Bailey: A Method for automatically recording the Oxygen Intake of Living Tissues, by Dr. T. A. Bennet-Clark; The Respiratory Quotients of Succulent Plants, by Dr. T. A. Bennet-Clark; On the Cultivation in Artificial Media of *Catenaria anguillulæ*, a Chytridiacean Parasite of the Ova of the Liver Fluke, *Fasciola hepatica*, by Prof. J. Bayley Butler and Annie Humphries; Factors which Determine the Nutritive Value (Stock-carrying and Fattening Capacity) of Untreated Natural Pastures, by E. J. Sheehy; A Comparison of some European and American Virus Diseases of the Potato, by Dr. Paul A. Murphy and Robert McKay. Pp. 249-358+plates 13-18. (Dublin: Hodges, Figgis and Co.: London: Williams and Norgate, Ltd.) 10*s*.

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended 31st March, 1932. (M.O.348). Pp. 54. (London: H.M. Stationery Office.) 1*s*. net.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (New Series), No. 8, August. Abstracts Nos. 1352-1529. Pp. 251-290. (London: H.M. Stationery Office.) 1*s*. net.

Journal of the Institute of Actuaries Students' Society. Vol. 4, No. 1. Pp. 90. (London: Charles and Edwin Layton.) 3s.

Philosophical Transactions of the Royal Society of London. Series A, Vol. 231, A697: A New Apparatus for Determining the Relationship between Wave-lengths of Night and the Fundamental Standards of Length. By J. E. Sears, Jr., and H. Barrell. Pp. 75–145. (London: Harrison and Sons, Ltd.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1461 (T.2945, A, B, and C): Design and Test Data for Aircraft Radiators. By C. Anderton Brown. Pp. 56+24 plates. (London: H.M. Stationery Office.) 3s. net.

Aeronautical Research Committee. Report for the Year 1931–32. Pp. iv+96+5 plates. (London: H.M. Stationery Office.) 2s. net.

Journal of the Chemical Society. September. Pp. vi+2281–2504+x. (London: Chemical Society.)

The Proceedings of the Physical Society. Vol. 44, Part 5, No. 245, September. Pp. iv+529–624+xxii. (London: Physical Society.) 7s. net.

Proceedings of the Linnean Society of London, Session 1931–32. Part 4. Pp. 73–150. (London: Linnean Society.) 2s. 6d.

Transactions of the Institute of Marine Engineers, Incorporated Session 1932. Vol. 44, No. 8, September. Pp. 375–426+xxxiv (London.)

Quarterly Journal of the Royal Meteorological Society. Vol. 58 No. 247, October. Pp. 377–498+viii. (London: Edward Stanford. Ltd.) 7s. 6d.

Proceedings of the Royal Society. Series A, Vol. 138, No. A834, October 1. Pp. 258. (London: Harrison and Sons, Ltd.) 13s.

Mathematical Notes published by the Edinburgh Mathematical Society. Edited by Dr. A. C. Aitken. Pp. xix. (Edinburgh.)

Proceedings of the Edinburgh Mathematical Society. Edited by Prof. H. W. Turnbull and Dr. E. T. Copson. Series 2, Vol. 3, Part 2, July. Pp. 77–150. (London: G. Bell and Sons, Ltd.)

The Botanical Society and Exchange Club of the British Isles. Report for 1931 (with Balance Sheet for 1930). By Dr. G. C. Druce. Vol. 9, Part 5. Pp. 535–816+plates 5–16. 10s. Report for 1931 of the Botanical Exchange Club. By P. M. Hall. Vol. 9, Part 6. Pp. 817–847. 4s. (Arbroath: T. Buncle and Co.)

Tenth Scientific Report on the Investigations of the Imperial Cancer Research Fund. Pp. viii+208+55 plates. (London: Taylor and Francis.) 30s.

Journal of the Royal Statistical Society. New Series, Vol. 95, Part 4. Pp. 607–788. (London: Royal Statistical Society.) 7s. 6d.

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 25th October, 1932. Pp. 40. (Newcastle-upon-Tyne.)

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol. 57, Part 2, September. Pp. 157–378+ii–cxii+xxiv+62 plates. (London: Royal Horticultural Society.) 7s. 6d.

Philosophical Transactions of the Royal Society of London. Series B, Vol. 221, B478: Analyses of Agricultural Yield. Part 4: Water-Table Movements on a Farm in Egypt. By Dr. W. Lawrence Balls, *in collaboration with* M. A. *Zoujloul.* Pp. 335–375+plate 33. (London: Harrison and Sons, Ltd.)

The Hannah Dairy Research Institute. Bulletin No. 4: The Engineering Aspects of the Condensing and Drying of Milk. By Dr. A. W. Scott. Pp. 120. (Auchincruive.)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol 7, No. 4, October. Pp. 275–381. (London: Cambridge University Press.) 12s. 6d. net.

Leeds Studies in English. Outline of a Theory of Language. By Alan S. C. Ross. Pp. 14. (Leeds.)

Notes from the Botanical School of Trinity College, Dublin. Vol. 4, No. 4, August. Pp. 145–251. (Dublin.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1378 (T.2955): Theory of Airscrew Body Interference. By C. N. H. Lock. Pp. 23+7 plates. 1s. 3d. net. No.1465 (Strut. 90): Distortion of Thin Tubes under Flexure. By Dr. A. J. Sutton Pippard. Pp. 5+4 plates. 6d. net. (London: H. M. Stationery Office.)

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on October 12th, 1932. Pp. 8. (London.)

Board of Education. Educational Pamphlets No. 91 (Industry Series No. 11): Trade Schools on the Continent. Pp. 110. (London: H.M. Stationery Office.) 2s. net.

Proceedings of the Linnean Society of London, Session 1931–32. Part 5: Presidential Address by Prof. F. E. Weiss, A Re-Examination of the Stigmarian Problem. Pp. 151–166. (London: Linnean Society.) 6d.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 71, No. 430, October. Pp. 541–684+xvi. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

OTHER COUNTRIES

Trinidad and Tobago: Forest Department. Administration Report of the Conservator for the Year 1931. Pp. 23. (Trinidad: Government Printing Office.)

Technical Books of 1931: a Selection. Compiled by Donald Hendry. (Twenty-fourth Issue.) Pp. 28. (Brooklyn, N.Y.: Pratt Institute Free Library.)

Field Museum of Natural History. Botanical Series, Vol. 8, No. 6: Revision of the Genus Cosmos. By Earl Edward Sherff. (Publication 313.) Pp. 399–447. (Chicago.) 50 cents.

Smithsonian Institution: Bureau of American Ethnology. Bulletin 111: The Village of the Great Kivas on the Zuñi Reservation, New Mexico. By Frank H. H. Roberts, Jr. Pp. ix+197+64 plates. (Washington, D.C.: Government Printing Office.)

The Science Reports of National Tsing Hua University. Series A: Mathematical and Physical Sciences. Vol. 1, No. 5, July. Pp. 159–214. (Peiping.)

South Australia: Department of Mines. Mining Review for the Half-Year ended 31st December, 1931. (No. 55.) Pp. 98. (Adelaide: Harrison Weir.)

Ibero-Americana. 1: Aztatlán, Prehistoric Mexican Frontier on the Pacific Coast. By Carl Sauer and Donald Brand. Pp. 92 (14 plates). 2 dollars. 2: The Comparative Ethnology of Northern Mexico before 1750. By Ralph L. Beals. Pp. vi+93–226. 1.35 dollars. 3: The Road to Cibola. By Carl Sauer. Pp. iv+58. 75 cents. (Berkeley, Calif.: University of California Press.)

Indian Journal of Physics, Vol. 7, Part 3, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 16, Part 3. Conducted by Sir C. V. Raman. Pp. 165–283. (Calcutta.) 3 rupees; 4s.

Kenya Colony and Protectorate: Forest Department. Annual Report, 1931. Pp. 27. (Nairobi: Government Printer.) 1s.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 59, Radio Research Board Report No. 2: i. The State of Polarisation of Sky Waves, by A. L. Green; ii. Height Measurements of the Heaviside Layer in the Early Morning, by A. L. Green. Pp. 80. Bulletin No. 60, Radio Research Board Report No. 3: i. The Influence of the Earth's Magnetic Field on the Polarisation of Sky Waves, by W. G. Baker and A. L. Green. Pp. 32. Bulletin No. 63, Radio Research Board Report No. 4: i. A Preliminary Investigation of Fading in New South Wales, by A. L. Green and W. G. Baker; ii. Studies of Fading in Victoria, a Preliminary Study of Fading on Medium Wave-lengths at Short Distances, by R. O. Cherry and Dr. D. F. Martyn; iii. Studies of Fading in Victoria, Observations on Distant Stations in which no Ground Wave is Received, by R. O. Cherry. Pp. 60. (Melbourne: H. J. Green.)

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India. Edited by K. K. Sen Gupta. Vol. 3, No. 4, April. Pp. 153–193+xii. (Calcutta.)

Memoirs of the Indian Museum. Vol. 10 (continued): The Copepoda of Indian Seas—Calanoida. By Lieut.-Col. R. B. Seymour Sewell. Pp. 223–408+6 plates. (Calcutta: Zoological Survey of India.) 9.10 rupees; 16s.

Records of the Indian Museum. Vol. 33, Part 2, June. Pp. 71–210+plates 5–6. 2.12 rupees; 5s. Vol. 33, Part 3, October. Pp. 211–325+plate 7. 2.12 rupees; 5s. Vol. 33, Part 4, December. Pp. 327–516+plates 8–15. 2.12 rupees; 5s. Vol. 33, Appendix: List of Literature referring to Indian Zoology (excluding Insecta) received in Calcutta during the Year 1931. Pp. xii. 4 annas; 5d. Vol. 34, Part 1, March. Pp. 79+7 plates. 2.12 rupees; 5s. Vol. 34, Part 2, June. Pp. 81–228+plates 8–17. 2.12 rupees; 5s. (Calcutta: Zoological Survey of India.)

Outline History of the Victorian Bush Nursing Association. By Sir James Barrett. Pp. 26. (Melbourne.)

Southern Rhodesia: Geological Survey. Bulletin No. 20: The Geology of the Country around Que Que, Gwelo District. By A. M. Macgregor. Pp. 113+14 plates. (Salisbury.) 2s. 6d.

Southern Rhodesia. Meteorological Report for the Year ended 30th June, 1931, together with Hydrographic Report for the Years ended 30th September, 1931, by the Department of Agriculture. Pp. 82. (Salisbury: Government Printer.)

Publications of the Observatory of the University of Michigan. Vol. 4, No. 12: Variations of Emission Lines in Three Be Spectra. By Ralph H. Curtiss. Pp. 163–174. Vol. 4, No. 13: A Spectroscopic Survey of the Brighter Be Stars. By Dean B. McLaughlin. Pp. 175–198+2 plates. (Ann Arbor, Mich.)

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 460: Theory of Voltage Dividers and their Use with Cathode Ray Oscillographs. By Melville F. Peters, George F. Blackburn and Paul T. Hannen. Pp. 81–114+10 plates. 10 cents. (Washington, D.C.: Government Printing Office.)

U.S. Treasury Department: Coast Guard. Bulletin No. 21: International Ice Observation and Ice Patrol Service in the North Atlantic Ocean, Season of 1931. Pp. iii+52+19 plates. (Washington, D.C.: Government Printing Office.)

The Memoirs of the Imperial Marine Observatory, Kobe, Japan. Vol. 5, No. 2, July. Pp. 51–103. (Kobe.)

Bulletin of the Imperial Agricultural Experiment Station in Japan. Vol. 3, No. 3, March. Pp. 157–242+plates 3–15. (Nishigahara, Tokyo.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Fourth Series (Biology), Vol. 7, No. 3, August. Pp. 313–455+plates 11–12. (Tokyo and Sendai: Maruzen Co., Ltd.)

The Medical and Scientific Archives of the Adelaide Hospital. No. 11 (for the Year 1931). Pp. 59. (Adelaide: Harrison Weir.)

Commission Internationale de la Haute Atmosphère. Comptes rendus des jours internationaux 1924. Première partie: Tableaux des sondages réussis, cartes synoptiques. Pp. iv+161. Deuxième partie: Diagrammes indicateurs, folio des tephigrammes des sondages par ballons-sondes, tables de chiffres pour le calcul de l'entropie de l'air. Pp. 24. (London: International Commission for the Exploration of the Upper Air, c/o Royal Meteorological Society.)

Gold Coast Colony. Report on the Survey Department for the Year 1931–32. Pp. ii+16. (Accra: Government Printing Office; London: The Crown Agents for the Colonies.) 2s.

CATALOGUES

An Illustrated Catalogue of Old Prints in Colour and Line, chosen chiefly for their Decorative Charm, including Plates of Flowers, Birds, Sporting Subjects, Swiss and English Views, Costumes and Maps. (No. 181.) Pp. 28+16 plates. Catalogue of Botanical Literature in all its Branches, including Books on Gardening and Floriculture, Regional Floras, Cryptogamic Botany, Serial Publications, etc. (No. 201.) Pp. 36. (London: Dulau and Co., Ltd.)

Zenith "Vit-Bond" Wire Wound Resistance Units. Pp. 8. (London: Zenith Electric Co., Ltd.)

Ephedrine B.D.H. Pp. 4. (London: The British Drug Houses, Ltd.)

Catalogue de Livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 22.) Pp. 118. (Paris: Libr. Adrien-Maisonneuve.)

Catalogue of New and Special Apparatus. (List No. 90a.) Pp. 20. (London: A. Gallenkamp and Co., Ltd.)

A Modern Library, mainly English Literature and Criticism. (No. 464.) Pp. 28. (Cambridge: Bowes and Bowes)

British Super Protex Glass for X-Ray Purposes. Pp. 8. (London: Cuthbert Andrews.)

SATURDAY, NOVEMBER 12, 1932

CONTENTS

Editorial and Publishing Offices:
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ST. MARTIN'S STREET, LONDON, W.C.2

Factors of Industrial Development*

AMONG the duties charged on the Economic Advisory Council is that of considering the possibilities of new industrial development and particularly the measures which could be taken to foster the growth of new industries, whether they arise as the result of the application of the creative discoveries of modern science or not. The growing burden of the unemployment problem and the seriousness of the general economic position has induced the Council to pay particular attention to the relation of research to industrial development. It is at last being realised that industrial research is an important factor in the unemployment situation, and one that tends to create employment or at least to compensate for the displacement of employment in other fields as a result of increased mechanical efficiency or other changes.

It is probable that we have reached the end of an era in which the creative discoveries of science as applied in the electrical industries, automobiles, radio and the cinema, have found employment for millions and absorbed in productive work a large proportion of the increasing population of the world for whom under the old conditions no work could have been found. The advent of power production has already closed that era and brought new problems, the solution of which so far has eluded mankind. In the new era, scientific and industrial research are of equal importance as assisting to develop that flexibility which is essential if modern industry is to deal with problems of the magnitude of that of unemployment; and in equipping the nation to deal with the dislocation and reorganisation inseparable from the dynamics of industry or society.

In March 1931 the Economic Advisory Council appointed a Committee to consider broadly the position of industrial research in Great Britain, and in particular whether the proposal to establish a new central national research organisation would facilitate the promotion of industrial development as a means of providing additional employment. The report of this Committee gives a valuable survey of the existing organisation of industrial research in Great Britain with the definite object of discovering any overlapping which could be prevented by further co-ordination, or any gaps which should be filled either by

* Economic Advisory Council. Report of the Committee on New Industrial Development. Pp. 29. (London: H.M. Stationery Office, 1932.) 6*d*. net.

the development of existing organisations or by the creation of some new body, as was urged by Mr. A. P. M. Fleming in a paper before the Department of Industrial Co-operation at the British Association centenary meetings last year.

The major part of the survey of existing resources is devoted to a critical review of the Department of Scientific and Industrial Research and its research establishments, including the research associations, and the report places the responsibility for much of the prestige of this young Department on the exceptional combination of scientific attainments, administrative ability, zeal, persuasiveness and sympathetic understanding of the point of view of business possessed by those at the head of its staff. This is a tribute worth noting in view of a common tendency particularly in official circles to deny the possibility or existence of such combination of scientific attainment and administrative ability. With regard to the permanent institutions of the Department, the Committee comments on the absence from the National Physical Laboratory of any dubious schemes designed purely to be impressive, and it considers that the Laboratory has developed as an organic structure in response to clearly defined needs and purposes. Similarly such primary needs of the community as food, fuel, water-supply and buildings appear to be adequately covered by the other research establishments of the Department, and the work carried out by the Bridge Stress Research Committee, the Steel Structures Research Committee and the Locomotive Experimental Station Inquiry Committee is regarded as evidence of the ability of the Department to improvise a temporary special organisation to meet the need for special scientific investigation in any field of industry.

Commenting on the Research Associations scheme, the Committee points out that the Advisory Council which adopted the scheme deliberately rejected the idea of forming one central institution to which industries could turn for assistance in research, and suggests that experience has confirmed the view that a research association which a particular industry controls, for which it feels responsible and in which it takes a pride, is able to contribute to the development of mutual understanding between men of science and industrialists in a way that would not be open to a central institution. Moreover, the Research Associations have made discoveries of financial importance and have to a remarkable extent converted the British manufacturer from an attitude of scepticism to one of appreciation of the potentialities of scientific research. They have also established special departments for development work designed to assist in testing the results of their investigations on a practical scale, and it is clear that the Committee has formed a very high opinion of the merits of the Research Associations scheme.

Without detracting from the praise deservedly extended to many of these Associations, it is possible to feel that the Committee on Industrial Development is a little unduly optimistic about both their achievements and future prospects. Few of the Associations are self-supporting, and in fewer still has there been any sign that the industry as a whole is prepared to shoulder the full burden of financial responsibility of its research needs. In consequence, there is uncertainty about the continuance of the Associations, and the initiation of large scale development work is a much less simple problem than that confronting the research departments of large units of progressive industry, such as the General Electric Co., Metropolitan-Vickers, and Imperial Chemical Industries.

The Committee is accordingly unconvinced that an important gap exists in our existing arrangements for industrial research, which would be filled by the creation of a new national research organisation to draw up programmes of research into the application in industry of ideas, inventions, or processes at present undeveloped and likely to remain undeveloped, and to institute the necessary researches. While admitting that notably in the older industries, much research which might usefully be pursued is at present left undone, the Committee suggests that the need would be met by the Department of Scientific and Industrial Research establishing a branch for the purpose of initiating the stimulation of research in such industries, and directs attention to the readiness of the Department to create organisations of its own in important industrial fields where it recognises the existence of a need for research.

The proposal for the creation of a new central research organisation rests on a distinction drawn by its supporters between research directed to the improvement of existing industries and that directed to the creation of new industries, the latter being normally responsible for increasing employment. While it is undoubtedly true that the application of scientific discoveries resulting

in the creation of new industries has given employment to millions, under modern conditions the displacement effects are becoming more serious, so that rise of a new industry frequently means the contraction of an older established one. So far as employment is concerned, the national importance of scientific research as a factor in determining the rise of new industries lies rather in the consequent ability of the nation to minister to the new needs, thus giving employment to some or all of those inevitably displaced by the disappearance of needs to which the older industries ministered. In the minds of certain leaders of industry, such as Sir Harry McGowan, to judge from his presidential address last year to the Society of Chemical Industry, there are even doubts whether violent fluctuations caused in industry by, among other factors, the sudden exploitation of a scientific discovery, are really beneficial; and in the type of planning towards which the world is tending, provision for fundamental research and the deliberate exploitation of its results either by the State or by industry seems essential.

Apart from this factor, it is at least open to doubt whether the distinction drawn between the two types of research is valid and whether scientific research can be directed specifically to the creation of new industries. We are still without a real technique of discovery, and important industrial developments as often as not are based on purely fortuitous discoveries. In general, the fundamental discoveries have resulted from patient and disinterested investigations, the quest of truth for its own sake. Where scientific research has produced striking results from its direct application to industrial purposes we have entirely different conditions: a mass attack by a team of specialists on a clearly defined objective in a field where a considerable body of accumulated knowledge already exists.

The Committee refers to the work of the Fuel Research Board on the economical extraction of oil from coal as an example of the ability of the Department of Scientific and Industrial Research to take the initiative in problems of this type as they arise, and accordingly it considers that here again the proposed new body would be likely in practice, by confusing purposes and distracting effort, to injure rather than forward the cause of scientific research in industry. Even in regard to large scale tests the requirements of development research appear to be sufficiently covered by the machinery of the Department of Scientific and Industrial Research, although the Committee recommends that it is desirable that there should be at the disposal of the Government a small fund capable of being readily used for research developments, and that provision should continue to be made in the Department's annual estimates for such a sum for expenditure on research developments or unforeseen requirements.

The report of the Committee makes a convincing case for the adequacy of the existing Government organisation for the promotion of industrial research, which may be readily accepted without suggesting that the position is entirely satisfactory. The real trouble is that indicated in the last annual report of the Department. While the existing organisation is adequate and sufficiently flexible to meet the varied needs, there is not yet a sufficient general acceptance in industry of the fundamental importance of research as a fixed charge comparable with obsolescence, insurance, etc., and an essential factor in progress. The work of the Department is limited by the extent to which a scientific outlook prevails in industry, and the real task is one of educating industry to use the facilities already available rather than to create a new organisation with ill-defined objectives and probable overlapping with the functions of existing organisations. It is only as this task of education, both in industry and in public affairs, is tackled with real energy and efficiency that we can hope to close those gaps which exist in our national organisation of research or secure the full utilisation of the facilities already available.

Despite the fact that new industries are not in general created by direct scientific discoveries, long range fundamental research is of prime importance to the nation, and at the present time the declared policy of the Committee of the Privy Council to concentrate available funds on the work of the most immediate practical value to industry tends to create a dangerous gap. It is the long range type of research that is most liable to be neglected by industry, and the present report has little to say on the manner in which the task of education is to be undertaken or the serious danger the situation represents to posterity. Admittedly the available facilities are not yet being fully utilised, and the stability of certain features of the national organisation such as the Research Associations is uncertain. We cannot, for example, regard the position as satisfactory

when an industry representing £500,000,000 of invested capital has difficulty in providing the sum of £21,000 required to maintain a Government grant of £5,000 to its research association, and this in spite of the successful conclusion of researches on insulating oils and buried cables which at an aggregate cost of about £27,000 have resulted in total savings to the industry of at least £300,000 a year as well as adding something like £4,000,000 to the value of the existing cables.

Important sections of industry still notoriously owe their difficulties less to economic conditions than to the past neglect of scientific methods and research. The Report of the Committee on New Industrial Development underlines once more the necessity for a more widespread and intensive educational campaign to demonstrate both the capacity of scientific research to provide, not the ready-made solution of industrial difficulties but the technique of solution, and the ability of the scientific worker to co-operate in the conduct not merely of the investigations themselves but also of those administrative problems involving scientific and technical factors which abound everywhere in industry and the State to-day. It is only as a result of such an educational effort that we can expect to find alike in industry and in the State a scientific outlook in high places which will make possible the statesmanlike planning and utilisation of our full resources, whether of the Department of Scientific and Industrial Research, of industry or of the universities, and the prosecution of industrial and scientific research in all its varied phases from the fundamental or long range scientific research to the semi-technical scale in a measure commensurate with national needs.

Himalayan Exploration

The Italian Expedition to the Himalaya, Karakoram and Eastern Turkestan (1913–1914). By Filippo De Filippi. With Chapters by G. Dainelli and J. A. Spranger. Pp. xvi+528+20 plates. (London: Edward Arnold and Co., 1932.) 50*s*. net.

WE expect this production will rank as one of the most elaborate books of travel published, both as regards letterpress and the three hundred illustrations, not to mention maps and mountain panoramas. It is indeed worthy of such a leader as Cav. Filippo De Filippi, so well known as a traveller and explorer in the Himalayas, which he first visited as a member of H.R.H. the Duke of the Abruzzi's celebrated expedition to the Baltoro glacier in 1909, of which the author was also the chronicler.

The expedition occupied from August 1913 until December 1914. It was originally described in the Italian edition published in 1923 of which this is mainly a translation, but has been treated by the author as a new and revised edition. This has given him an opportunity of referring to expeditions which have taken place since the original was issued. He has also added a general chapter on the scientific results which have been only partly published in detail up to date. Two additional chapters have also been added by Prof. Giotto Dainelli and Mr. J. A. Spranger. The author remarks in the preface: "I do not know if any other trans-continental expedition has ever been organised through such difficult regions, crossing vast desert tracts devoid of sustenance for man and beast; with so extensive and complex a programme of scientific research, requiring not only a considerable company of trained workers but also very cumbersome equipment, including quantities of the most delicate instruments, which had to be transported with infinite precautions and needed unremitting care and supervision." This quotation will give some idea of what had to be accomplished over, perhaps, the most difficult country in the world.

The expedition was essentially a scientific one, and had for its object investigations into geology, glaciology and morphology, anthropology, meteorology, and, above all, the author was interested in gravimetric measurements and the deviation of the plumb-line with the view of investigating conditions of isostasy "when expertly carried out in the heart of the Himalayas and Karakoram, where great altitude and various practical difficulties had combined, up till now, to prevent the making of such delicate observations." A further object was to make systematic observations for terrestrial magnetism, and finally, the exploration and mapping of the eastern end of the Karakoram and its unknown glaciers.

It was certainly an ambitious programme, which so far as we know, was efficiently carried out, though the detailed scientific accounts are not yet completed. Cav. De Filippi took with him a carefully selected band of Italian experts with Commander (now Admiral) Prof. Alberto Alessio, as second in command. Col. Henry Wood, R.E., of the Survey of India and Mr.

John Spranger were the two English members. In all there were eleven Europeans, each an expert in his own line, and two Indian surveyors, Rai Sahib Jumna Prasad and Rai Sahib Shib Lal, lent by the Government of India.

The volume before us is mainly descriptive of the journey, localities and their people, passed through from the plains of India to the heart of the Himalayas, and we fancy little has escaped the notice of this observant traveller. Local interest has been added by a sketch of the history and religions of these remote parts. In search of information every available source has been used. Numerous notes and references are scattered throughout the pages.

After passing from India through Kashmir, taking geodetic and geophysical observations at various places on the way, the expedition reached Skardu, the capital of Baltistan. There they spent the winter of 1913–14; established observing stations and settled down to a regular series of observations, while Prof. G. Dainelli made geological excursions in the province of Baltistan, at the same time examining the social and economic condition of the people he came across. Perhaps in no part of the world is a larger proportion of the inhabitants dedicated to the service of religion; this subject, therefore, naturally occupies much attention.

In the spring of 1914 the expedition moved up the Indus to Leh, the capital of Ladak, "a true little capital, the seat of a tiny cosmopolitan world with various classes and categories of citizens." Here headquarters were established for 2½ months. The time was occupied with geophysical, meteorological and magnetic observations and excursions in the neighbourhood, by which Prof. Dainelli continued his researches, a description of which he contributes in two chapters. In the middle of May 1914 the whole expedition left Leh for the Eastern Karakoram, crossing by the Lhang-la into the Shayok valley *en route* for the Depsang Plateau where, on June 1, a base camp was formed at a height of 17,590 ft. above sea level from which to work the summer campaign of exploration and for the setting up of an observing station.

It was from here the main exploring work was undertaken; the survey of Rimu glacier and of the upper waters of the Shayok and Yarkand rivers being the chief objective. Other trips connected with geological research were also undertaken. Although the Rimu glacier had often been seen before, this is, we believe, the first time it was thoroughly explored and mapped. It forms a peculiar feature in that the continental water divide between Central Asia and India actually crosses this immense glacier; the waters from one branch flow into the Shayok river and thence to the Indus, and from another branch to the Yarkand river, which is eventually absorbed in the Tarim basin of Central Asia. Four chapters are devoted to the exploration of this area and to the discussion of the various topographical problems of this complicated jumble of mountains and glaciers.

In the final chapter a synopsis of results is given. Observations for deviation from the vertical and anomalies of gravity were taken at a series of fourteen stations beginning at Dehra Dun in India and ending at Tashkent in Central Asia, most of these being at a great height above mean sea level. Relative gravity was determined by Sterneck's modified apparatus, eight pendulums being used. For the determination of the deviation of the plumb-line, where it is necessary to make a comparison between astronomical and geodetic co-ordinates, the zenith telescope and transit instrument were used. Difference of longitude was determined by wireless signals specially transmitted from Lahore and timed for the expedition at Dehra Dun. By this means it was possible to obtain a more accurate value of the astronomical longitude than could have been done before the days of wireless.

These observations have an important bearing on questions of isostasy, which have occupied the attention of Indian geodesists since the time of Everest. We have not, however, had an opportunity of seeing the results, though it is stated the observations "confirm the general conclusions drawn by the Survey of India from their own, taken in connection with those of the Russian geodetic service: namely, that gravity values are generally in excess in the Himalayas and Karakoram ranges, and in defect to the south and north of them, pointing to equal conditions of compensation, or of lack of compensation, in the Indo-Gangetic plain and the plain of Turkestan." A complete set of magnetic observations was also made at each station. The topographical work, carried out by Col. Wood and Mr. Spranger and the Indian surveyors Jumna Prasad and Shib Lal, has been embodied in a map on a scale of 1/250,000, which is with the book.

A full set of meteorological observations was

taken and pilot balloon ascents were made: "these have resulted in a large quantity of new data."

As of interest in the realm of geology, it is stated, "contrary to the current view that this group of mountain ranges has not been subject to great glacial expansions in the Quaternary Age, Dainelli has found the occurrence of two great expansions, and of at least four minor ones." "Particularly interesting is the demonstration of two periods of uplifting which took place in the Quaternary; one affecting also a large portion of the Trans-Himalayan region, the other only the chain of the Himalaya (Pir Panjal). These uplifts have a general bearing on the question of the glacial period." The geological investigations made, and the specimens collected, by the members of the expedition should add much information about this region.

It is stated that there will be, when complete, ten volumes of scientific results from the expedition. As a book of reference and a guide to future explorers the volume before us is invaluable; it is, of course, impossible in a short review to do justice to it. There will soon be little left that has not been explored and mapped in that area generally known as the Karakoram. A good deal has been done since the De Filippi expedition.

We think the maps accompanying the volume might with advantage have had more of the names mentioned in the text inserted on them, without any overcrowding; it would have made the text easier and quicker to follow. The volume contains an extensive bibliographical index and the translation has been well done by Mr. H. T. Lowe-Porter.

H. L. CROSTHWAIT.

Social Anthropology in Epitome

Early Beliefs and their Social Influence. By Prof. Edward Westermarck. Pp. vi+182. (London: Macmillan and Co., Ltd., 1932.) 7*s.* 6*d.* net.

IT is not given to every anthropologist to be pre-eminent alike in the field and in the study; and it is only when this happy combination of interests occurs that facts and ideas are likely to be brought into harmonious relation. Prof. Westermarck actually started his career as a theorist, obtaining as a comparatively young man the most brilliant success with his "History of Marriage"—a work which later he crowned, if it was scarcely possible to surpass, with his admirably documented treatise on "Comparative Morals". On the other hand, he has given many of his best years to first-hand study of the social institutions of Morocco, where so many grades of culture exist in juxtaposition that a stratigraphy covering all the transitional phases between savagery and civilisation will reward research, given wide enough acquaintance with the conditions and the requisite analytical acumen. Thus it is fitting that, in the ripeness of his knowledge and experience, such a thinker should set himself to give summary expression to his more general convictions concerning methods and results.

Those familiar with Prof. Westermarck's books —and they will amount to most serious students of anthropology—will perhaps find here no fresh surprise sprung upon them, but on the other hand will be glad to have the principles on which he has come to rely formulated and defended with such masterly clearness. Thus it is well known that Prof. Westermarck has always sought to steer a middle course between Frazer's and Durkheim's attempts to differentiate magic from religion. He agrees with the one that they severally imply coercion and conciliation; but with the other that both alike relate to the supernatural, and therefore have more in common than Frazer's notion of magic as "the bastard sister of science" would make it possible to assume. But this compromise involves difficulties of its own. Thus he writes: "It has only reference to religion in the abstract, not to the various religions. In the popular sense of the word, which certainly must be respected, *a* religion may include many practices which are what I have called magical"; and he goes on to hint that the Christian use of holy water and even the Eucharist itself have a magical import. But surely, to deny a religious character to the central mystery of the typical religion of civilisation is simply to play with words, unless indeed a valuation is intended such as would be quite out of place in a purely scientific account of an evolutionary process.

Further, believing as he does that religion is born of fear and originates in emotions excited by contact with the uncanny, Prof. Westermarck is disposed to minimise its influence as a social force; so that one cannot but suspect him of conceiving it too abstractly, and therefore failing to do justice to its nature as a living and working

institution. When he says that the importance of the religious bond as apart from the influence of marriage, local proximity and a common descent has been slight in its bearing on the growth of social organisation, or when, again, he insists that "the moral influence of religion has often been greatly exaggerated", he seems to me to be eviscerating human history in the interests of a bloodless category. Thus I suppose that he would not deny the social and moral activities of the Christian Church, but would nevertheless declare the religious element in them to be but slightly responsible for the concrete results.

Obviously, if one starts from a primitive impulse so limited by definition that it can never alter by way of expansion or sublimation, then any progress that occurs in a complex with which it is connected must be due to something else. If, however, one plays fair all round and treats the remaining impulses concerned in similar fashion, thereupon it becomes quite impossible to account for any development at all. In fact it puzzles me altogether how 'religion' can be anything different in essence from *a* religion, since I take it to be rather the *formule d'ensemble* that covers any and every religion as such, however variously it may have evolved.

Meanwhile, whether the reader is always in sympathy with the point of view or not, he is sure to derive profit from the masterly grip on the relevant evidence which is displayed in the treatment of every special topic alike. One feels that half a century of study and experience is behind the elucidation of that many-sided theme, the relation of the sexes, together with the resolution of the paradox that primitive religion sets a value both on chastity and on unchastity in different contexts. Again, many side-lights are here thrown on the history of morals, as for example in relation to the duties of charity and hospitality towards men and of respectful behaviour towards gods. Moreover, with morality, law is so closely bound up that the part played by methods of procedure such as the oath or the ordeal in the administration of justice is duly considered in turn. Thus we have here in compact and lucid shape the mature reflections of one whose command of fact and independence of mind entitle him to rank among the foremost exponents of anthropology in all that variety of aspects constituting its social side.

R. R. MARETT.

Implications of Science

The Universe of Science. By Prof. H. Levy. Pp. xiii + 224. (London: Watts and Co., 1932.) 7*s.* 6*d.* net.

THERE is no end to the number of philosophical or quasi-philosophical puzzles with which the present-day physicist may divert himself; the marvel is that, in all the pother and hurly-burly of questioning of fundamentals, there remain a few calm souls content to weigh and to measure, unperturbed by the dust raised by iconoclasts who question the very possibility of exact measurements.

"The Itch of Disputation will prove the Scab of the Churches," said an apophthegmatical Provost of Eton more than three hundred years ago. The correctness of view of those who describe, in similar vigorous terms, the grammars of science which pour from our presses in ever-increasing numbers, may be questioned; always provided that we measure first, and theorise about it afterwards, there is much to be gained, and nothing to be lost, by hurling shards at dogmas which seemed, a generation ago, fixed and unassailable.

Moreover, the layman wants to know all about it; his papers proclaim that the universe is dissolving into radiation, that the author of the universe is a mathematician, that the principle of free-will has invaded physics, that there is not 'a particle of evidence in favour of determinism'; and we are told that things not observable are not real, and must be omitted from our theorisings—an assertion which, like many of these novel sayings, is not so new as it appears to be; the schoolman who told us *de non existentibus et non apparentibus eadens est ratio* had the root of the matter in him.

A certain amount of looseness of definition is apparent in some of the topics which are occupying the attention of theorists, and one suspects that no small number of the disputes that have arisen would prove to be verbal if the protagonists would only define carefully such terms as *indeterminism* and *free will*. Uneasiness in these matters of definition is to-day, curiously enough, more apparent in the biological than in the physical sciences, and it is interesting to note that, with a certain hesitation, the suggestion has been made that botanical science might possibly be the better for the loss of the *Reiss-begriff*. This is perhaps going too far, even though plant physiologists may, in the past, have attached queer connotations to

the notion; define your terms strictly and stick to the definitions, is a two-century old piece of advice, which represents the most profitable line of action.

Prof. Levy's contribution to the study of these problems merits careful attention. It is well fitted, in its clarity of style and in the elementary nature of its exposition, to the needs of the amateur in these matters. Mayhap he may be a trifle bewildered at first, for Prof. Levy's attitude is distinctly not that of the indeterminist school. Indeed, he roundly says that "the interpreters of the new knowledge and understanding, Sir James Jeans, Sir Arthur Eddington, Professor Millikan, General Smuts . . . have almost without exception approached their problems against a background of outworn Idealist Philosophy, none the less significant in its colouring because it has been unobtrusively though tacitly present. The pendulum has swung in the opposite direction. It is a reaction against the confident materialism of a past generation, as dogmatic and as uncritical as was its religious counterpart."

Which is very well; but we could wish that writers of all shades of opinion would furnish themselves with accurate critical and historical knowledge ere they attempt to see the present against the background of the past. What is this "confident materialism" against which an already "outworn Idealist Philosophy" has reacted? If the allusion is to the *Kraft-und-Stoff* movement of the mid-nineteenth century, it must be remembered that its vogue was short, and while sciolists might and did continue to rail against the 'dead mechanism' of the universe described by science, Buchner's book read oddly enough even to a young inquirer of the later eighteen-nineties. Mach and Pearson had already pointed the way to a saner synthesis which is certainly not outworn in the nineteen-thirties.

Scientific methodology—and with this attitude Prof. Levy is, we think, in agreement—is as deterministic, in the philosophic sense, as ever it was. Even the uncertainty principle is envisaged in terms of the mechanical pushes and pulls to which our macroscopic world has accustomed us, and the uncertainty is an uncertainty of the *where* and *when* rather than an uncertainty produced by a breakdown of the law of causality itself.

Such topics, and the deductions therefrom, are of great interest to the present-day world, and the author handles them in vigorous and stimulating fashion. His writing abounds in apt allusion and illustration, and the chapter on mathematics, which is written in an endeavour to show to those unfamiliar with the science "how mathematical methods are used as an instrument in scientific discovery", is an admirable piece of elementary exposition. His second chapter will be read with considerable interest. It passes the compass of any one man's mind to see as a whole the moving shadow-shapes that constitute his perceptual universe, and, in the nature of the case, whenever he studies a portion of that universe, he must make what the author terms an 'isolate' of it. Such a necessary isolation bears with it philosophical consequences which are discussed in some detail.

One or two minor omissions require notice; it is curious, in such a work, to find no detailed treatment of the terms 'cause' and 'causality'; Heisenberg's name is not indexed, and there is no reference to the uncertainty principle; Mach receives no mention, and Pearson is referred to twice, on topics quite incidental to the major issues.

There is no finality in these matters, and Prof. Levy has contributed but one more term to an unending series; his contribution is, however, both scholarly and important, and will compel the interest alike of the layman and the expert.

ALLAN FERGUSON.

Short Reviews

The Heart of England. By Edward Thomas. (Open-Air Library.) Pp. xvi + 228. (London and Toronto: J. M. Dent and Sons, Ltd., 1932.) 3*s*. 6*d*. net.

IT would be difficult to conceive of a more apt title to this collection of exquisite open-air essays than that chosen by the author, whose little volume is by its very simplicity and fragrance bound to appeal to many readers, especially of natural history, as being something that will live. The author must indeed have been inspired when he took up his pen to describe with such vivid directness his impressions of the country he loved so well. To use his own words: "You exult because you are alive and your spirit possesses this broad, domed earth."

The book is divided into five parts: "Leaving Town", "The Lowland", "The Upland", "The Mountains", and "The Sea". After reading such a volume as this it is with a feeling akin to consternation to realise that though the first publication was in 1906 it was not reprinted until 1932. English literature indeed lost one whom it could ill afford to spare when Edward Thomas was killed in Flanders during the War.

Air Ministry: Meteorological Office. British Rainfall, 1931: the Seventy-first Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1931 as recorded by over 5,000 Observers in Great Britain and Ireland. (M.O. 345.) Issued by the Authority of the Meteorological Committee. Pp. xxi+306. (London: H.M. Stationery Office, 1932.) 15*s.* net.

FOR the British Isles as a whole the rainfall of 1931 was 109 per cent of the average, the year being the ninth in succession with a general fall in excess. Over the country as a whole the rainfall of 1931 was less than that of 1930 but greater than that of 1929. In spite of the wet summer some places in south-east England had less than the average annual fall, and so did the north-west of Scotland where summer was dry, but a wet area with more than 130 per cent embraced the north English Midlands.

As in 1930, and, indeed, every year, there were some notable downpours which, however, were unusually frequent. These included the severe thunderstorms of May 27 in south-west England and south Wales, the widespread intense rains of June 14, the day of the Birmingham tornado and of a destructive cloudburst near Bootle in Cumberland, the long succession of torrential rains in August amongst which was the thunderstorm that on August 8 deluged Boston in Lincolnshire with 6 in. of rain, the Whitby floods of September 4 which were comparable with those in the same district on July 20 in the previous year, and finally the heavy falls in the west of November 3 when 7 in. fell at Trecastle.

Special articles discuss long rainfall records and the effects of unsuitable sites for rain and evaporation gauges. L. C. W. B.

(1) *Post-Primary Science.* By W. F. F. Shearcroft. Book 2: Second Year's Course. Pp. 234. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1931.) 2*s.* 6*d.*

(2) *Practical Science for Seniors.* By G. W. Manfield. Book 1. Pp. 96. 1*s.* 4*d.* Book 2. Pp. 128. 1*s.* 6*d.* Book 3. Pp. 160. 2*s.* (London: Macmillan and Co., Ltd., 1932.)

(1) This book is arranged in a somewhat unusual manner. It is divided into sections instead of the customary chapters, though more than one section is taken to deal with each branch of physics. Exercises alternate with the text in each section. They are printed in heavier type than the text, which is unfortunate as one is accustomed to associate heavy type with important information. The contents of the present volume include sections on gases, the atmosphere and atmospheric pressure, expansion of gases, liquids and solids, elementary mechanics, heat and elementary biology.

(2) These three booklets describe experiments in those branches of physics which have an important bearing on everyday life. Whenever possible, home-made apparatus of a simple nature is used. Instructions accompanied by clear illustrations make the assembly of the necessary apparatus an easy matter. Those pieces of apparatus which cannot conveniently be made at home are given with their approximate cost in a useful list at the beginning of each booklet. Short notes on the experiments are given at the end of each lesson. Book 1 contains experiments in elementary mechanics, on air, water and heat. Book 2 gives further experiments in mechanics and also experiments on air-pressure, water-pressure, light, magnetism and frictional electricity. Book 3 is devoted entirely to experiments in electricity. They are handy little books dealing with practical work only.

Winter Nights Entertainments: a Book of Pastimes for Everybody. By R. M. Abraham. Pp. ix + 186. (London: Constable and Co., Ltd., 1932.) 5*s.* net.

MR. R. M. ABRAHAM has brought together a very large number of examples, with illustrations, of card games and tricks, paper folding, coin and match tricks, string figures and tricks, knots and splices, games for the agile, toys, problems, etc., which will amuse those of all ages who like mental and digital dexterity to while away tedious hours of convalescence.

The making of string figures by primitive peoples is very widely spread and, as the author notes, it has engaged the attention of many field-workers. One would have thought that the author would have taken this opportunity to point out their real interest and to indicate where other examples may be found; instead of this he gives no references, though he has gleaned string figures mainly from Kathleen Haddon's (Mrs. Rishbeth) books. The process of making these has been modified in most cases, usually a new title has been substituted, and the localities have been omitted. For example: The tern is called the flying bird; the Apache door, the hurdle; the well, the fruit blossom; a temporary grass hut, is turned upside down to represent a parachute; the fly, crushing the cocoanut (*sic*)—a difficult feat!; the butterfly, the snail; the porker (described by Prof. Compton), the galloper (horse). Certainly the author has played tricks on the original discoverers of these string figures and on his unsuspecting readers. A. C. H.

Imperial College of Science and Technology: Huxley Memorial Lectures, 1925–1932. Pp. iii+12+30+38+27+16+21+28. (London: Macmillan and Co., Ltd., 1932.) 2*s.* 6*d.* net.

THE seven memorial lectures on different aspects of Huxley's life and work which are here collected give a very readable and impressive picture of the influence which T. H. Huxley still exerts in the field of science. It may be true that, as Aldous Huxley remarks in correcting G. K. Chesterton,

"Huxley *is* more of a literary than a scientific man", but while in one sense as a scientific man Huxley is now a mere historical figure, in another sense his influence as a man of science is still profoundly felt. The impetus he gave to scientific ways of thinking, not merely in some specialised field such as biology but also in the everyday affairs of life, has not yet died out. The battle he joined on the place of scientific method in education is still unfinished but his teachings and example are as inspiring as ever. The publication of these lectures in more permanent form should make known to a wider circle of scientific workers something of the sincerity and the humility which characterised Thomas Huxley, and should encourage them to take part in the yet unfinished warfare which he waged for scientific leadership and to emulate his own felicity of exposition of the aims and results of scientific studies. R.B.

Botany for Schools: a Textbook suitable for School Certificate and similar Examinations. By Dr. E. R. Spratt and A. V. Spratt. Pp. viii+363. (London: University Tutorial Press, Ltd., 1932.) 4*s*. 6*d*.

THE course of botany contained in these pages is claimed to cover completely the syllabus of the various School Certificate examinations. The authors also claim that the book is "suitable for the general reader who is interested in studying and experimenting with plants". Few textbooks are of interest or use to the 'general' reader; and this definitely is a textbook. A two years' botanical course is developed along orthodox lines. The photographs are good and are genuinely illustrative of certain botanical facts. The line diagrams, however, leave much to be desired, and in a number of cases they are misleading. The subject matter is presented in an appropriate form, but in places, especially the experimental physiology, it tends to be rather out of date.

As an examination textbook this work can be recommended, though it can scarcely be considered ideal or novel enough to be substituted for some of the better-known textbooks on the subject.

Bees, Wasps, Ants and Allied Insects of the British Isles. By Edward Step. (The Wayside and Woodland Series.) Pp. xxv + 238 + 111 plates. (London and New York: Frederick Warne and Co., Ltd., 1932.) 10*s*. 6*d*. net.

NO one who has read with interest the author's former well-known contributions to the "Wayside and Woodland" series could fail to welcome this, his last addition. The book is not claimed to be a rigid textbook on the Hymenoptera but sets out to give a general idea of these insects to field-naturalists. Therefore the treatment has necessitated the consideration of insects with no special regard to the natural sequence of groups, and only the more noticeable or important insects are fully described. A classified index of families and genera of the Hymenoptera is, however, appended. There are, also, a glossary of technical terms and a good general index. Step's books always have made good, interesting reading, but this, especially from the point of view of the profuse illustrations, can be looked upon as his *magnum opus*.

The Imperial Gazetteer of India. Vol. 26: *Atlas.* New (revised) edition. Published under the Authority of the Government of India. Pp. vii + 66 maps + 41. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 17*s*. 6*d*. net.

THE last edition of this atlas was published in 1909 and is now out of date in many respects. The present edition has two more plates than the old, the additions being an extra map of the distribution of crops, thus allowing twelve crops instead of eight to be shown, and one of Bihar and Orissa. Considerable changes have been made in the archæological sketch map, in the plate showing economic minerals and in the numerous town plans, and all the maps have been revised. In addition to the twenty-nine plates of general distributional maps, there are nineteen plates showing the whole of British India, the native States and Burma on a scale of 1 to 4,000,000. Afghanistan is shown on a small scale. There is a lengthy index.

How I was Born: the Plain Story of Birth and Sex. By Cyril Phillips Bryan. Pp. vii + 105. (London: John Bale, Sons and Danielsson, Ltd., 1932.) 5*s*. net.

IN this book, Mr. Bryan makes a sensible and interesting contribution to the literature of sex and its human significance. He gives a plain and straightforward statement which could be read with advantage by both adolescents and adults. There is nothing of a pornographic or even emotional character in the book, but much information which should afford wise guidance to healthy life and parentage. Among the many subjects clearly discussed are birth-control, sex determination, maternal impressions, inbreeding and heredity, hybrids and venereal disease. Many common fallacies are unveiled and curious cases described. In every respect the author has been successful in his endeavour to place before general readers the main facts relating to the whole range of sex.

Detachment of the Retina: a Contribution to the Study of its Causation and Treatment. By J. Ringland Anderson. Published for *The British Journal of Ophthalmology*. Pp. xiv + 207 + 7 plates. (Cambridge: At the University Press, 1931.) 20*s*. net.

IN his foreword, Sir John Parsons truly describes this monograph as being exhaustive and reliable and likely long to remain the chief source of information on detachment of the retina. Dr. Anderson gives a clear account, with full bibliographical references, of the present state of our knowledge of the causation and of the empirical mode of treatment which in certain cases affords some measure of success.

The Redwoods of California: The Past in the Present

By Prof. A. C. SEWARD, F.R.S.

THOUGH much has been written on the Big Trees of the Sierra Nevada and the Redwoods of the Californian Coast Range, the subject of these impressive examples of links with the past is by no means exhausted. It was my good fortune to wander in several Redwood groves in the spring of this year. Through the generosity of Dr. J. C. Merriam of the Carnegie Foundation and under

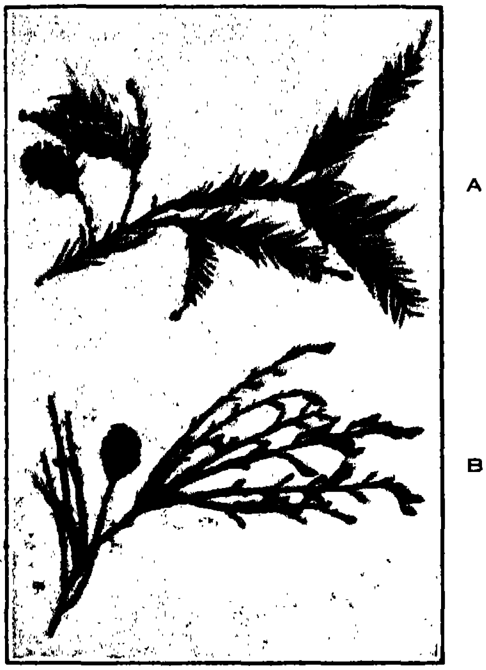

FIG. 1.—A, normal (two-ranked) foliage shoot; B, abnormal shoot of *Sequoia sempervirens* ($\frac{1}{2}$ natural size).

the expert guidance of Prof. Ralph W. Chaney of the University of California, Berkeley, visits were paid to the large groves north of San Francisco; and as guests of Prof. G. J. Peirce of Stanford University to the Big Basin south of San Francisco near the southern limit of the Redwood belt.

The two living species of *Sequoia* (Sequoyah, a Cherokee Indian who invented an alphabet), *Sequoia gigantea*, sometimes called *Wellingtonia*, the Big Tree, and *S. sempervirens*, the Redwood, are familiar as cultivated trees in British parks and gardens: it is the latter species with which this article deals. The Redwood was introduced into England soon after 1840 (the exact date is uncertain) and some specimens already exceed 100 ft. in height: this species is characterised by the red colour of the wood and soft, fibrous bark; foliage shoots with spirally disposed linear leaves, $\frac{1}{4}$–$1\frac{1}{4}$ in. in length, recalling those of the yew, which in the normal lateral branches are twisted by the torsion of the short stalks into two rows in one plane. On some leading branchlets and occasionally on abnormal lateral branches the leaves are shorter, more ovate and spiky and retain the spiral disposition. Though the normal two-ranked shoots are readily distinguished from those of *Sequoia gigantea*, abnormal branches bearing more tapered and scale-like leaves are very similar to the typical branches of the Big Trees. The ellipsoidal cones of *S. sempervirens* are surprisingly small, $\frac{3}{4}$–1 in. long and $\frac{1}{2}$ in. broad; they consist of 14–24 seed-bearing woody scales. The cones of *S. gigantea* are of the same form but rather larger. A typical foliage shoot and an abnormal shoot are shown in Fig. 1.

Extending more than half the length of the State of California lies a broad and relatively dry plain through which the Sacramento and San Joaquin Rivers flow respectively south and north into San

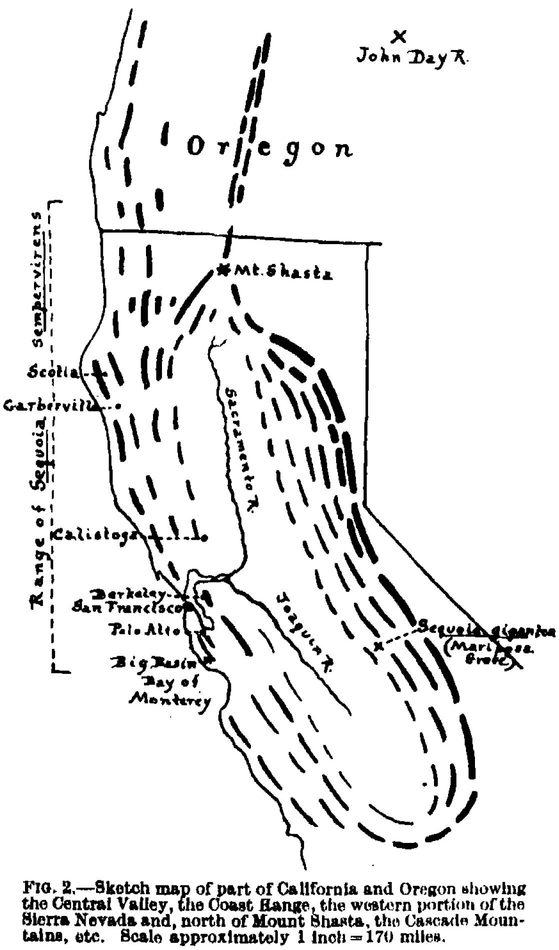

FIG. 2.—Sketch map of part of California and Oregon showing the Central Valley, the Coast Range, the western portion of the Sierra Nevada and, north of Mount Shasta, the Cascade Mountains, etc. Scale approximately 1 inch = 170 miles.

Francisco bay. The Sierra Nevada, including the highest mountains in the United States, form the eastern boundary, and the lower parallel ridges of the Coast Range lie between the western edge of the central valley and the Pacific Ocean. *Sequoia gigantea* is confined to a few localities on the Sierra Nevada, the most famous of which is the Mariposa Grove (Fig. 2): *S. sempervirens*, which has 'a

stronger hold upon existence', occupies a much larger territory to the west of the valley, from Monterey County in the south to a few miles north of the California-Oregon boundary, a distance of about 450 miles and with an average breadth of twenty miles. The Redwoods range from sea-level to an altitude of 3000 ft. Their distribution is not continuous. In some places the Redwoods form pure stands; there are forests in which the Douglas fir and other conifers are common associates; and areas in which the Redwood is absent either through human agency or from natural causes. A solitary giant by the side of the railway near Stanford University and the small town of Palo Alto (so named from the tree) is a conspicuous landmark.

A good road, the Redwood Highway, runs through the forests north of San Francisco and traverses a succession of groves which have been gradually acquired by the State, substantially aided by the Save-the-Redwoods League. Up to March of this year, nearly 30,000 acres of forest had been saved from destruction.

The climate of the Redwood belt varies within comparatively narrow limits; the temperature rarely falls below 15° F. and though it is said to rise to 100° F. or rather more, the average is 50°–60° F. From May to October is a dry season; actual precipitation as rain is confined to the wet season, November–April. The annual rainfall is usually between 20 in. and 60 in., though in places it occasionally reaches 100 in. During the dry months the forests bordering the coast receive an abundant supply of water from the dense clouds of fog which roll eastwards over the coast range hills. It is the summer fog—'the wet-winged angel of the rain'—which provides the humid atmosphere essential to the Redwoods.

Though surpassed by the Big Trees in girth, the Redwoods reach a greater height. One sees conflicting statements on the rival claims of the Redwoods and the Australian gum trees (*Eucalyptus*) to be described as the tallest in the world: the late Mr. J. H. Maiden of Sydney believed the Redwoods to be taller than the gum trees; some American botanists say that the Australian trees are the taller. But whether or not the Redwoods have longer stems, they are more majestic and make a stronger appeal to the imagination. It may be that in the future the alien eucalypts, which already play a conspicuous part in the Californian landscape, may exceed in height the native conifer. The highway on the north side of San Francisco bay passes through typical Californian scenery for several miles; low hills with smoothed rounded contours studded with clumps of live oak (*Quercus agrifolia*); on the lower ground sheets of the native blue and white lupin (*Lupinus bicolor*) and scattered patches of the glorious California poppy. Redwoods were first seen from the highway about thirty miles south of the small town of Garberville, with its typical 'main street', 230 miles north of Berkeley. Farther north we drove through miles of reserved forest areas, grove after grove of Redwoods with Douglas firs as their most striking companions. Between Garberville and Scotia, Redwoods are crowded on the hill slopes and along the deep valleys, where a fringe of alders, willows, and other trees forms the lowest zone of vegetation. Looking down from the steep hill-sides to the river-bed one sees weather-beaten and bleached stems and branches piled by the river in flood against obstructing rocks or stranded on banks of gravel, samples of contemporary vegetation on their way to entombment in river-borne sediment. Towering above the general level of the forest on the high rocky ridges, spires of *Sequoia* and *Pseudotsuga* (Douglas fir) were silhouetted against the blue sky; the more drooping branches of the Redwood forming a contrast to the straighter arms of the fir.

FIG 3.—A Redwood forest: the large tree is 54 ft. in circumference, 6 ft. from the ground. (Photograph by Dr. A. A. Cannon)

The black oak (*Quercus Kelloggii*), the tan oak (*Lithocarpus densiflora*), the Californian lilac (*Umbellularia californica*), the Madrõno (*Arbutus Menziesii*), representing in the new world the strawberry tree of the Killarney Lakes and the Mediterranean flora, easily recognised by the red polished bark, the mountain dogwood (*Cornus Nuttallii*), maples and many other trees are some of the commonest neighbours of the Redwoods. A pink oxalis (*Oxalis oregona*), *Trillium*, the poison oak (*Rhus diversiloba*), irises, the red columbine (*Aquilegia truncata*), sword ferns (*Polystichum munitum*), the lady fern, and the far-flung bracken are a few of the abundant plants on the forest floor.

It is difficult to realise the height of the taller Redwoods in forests where there are few or no standards of comparison. Some of the giants, if

transplanted to the Close at Salisbury, would reach to within a few feet of the top of the famous spire. There are few trees equal to the Redwoods in resistance to fungus diseases, insect pests and forest fires: the thick fibrous bark and the wood, which in healthy trees lacks resin-ducts, are almost indestructible. The ordinary method of reproduction is vegetative, not from seed: the trees have remarkable capacity for regeneration by suckers from the roots. One often sees a ring of tall trees with a huge broken or charred stump in the centre of the circle: the moribund parent had developed a group of suckers which in course of time gained independence. A prone stem draped with nests of sword fern and many flowering plants may form a plinth bearing slender

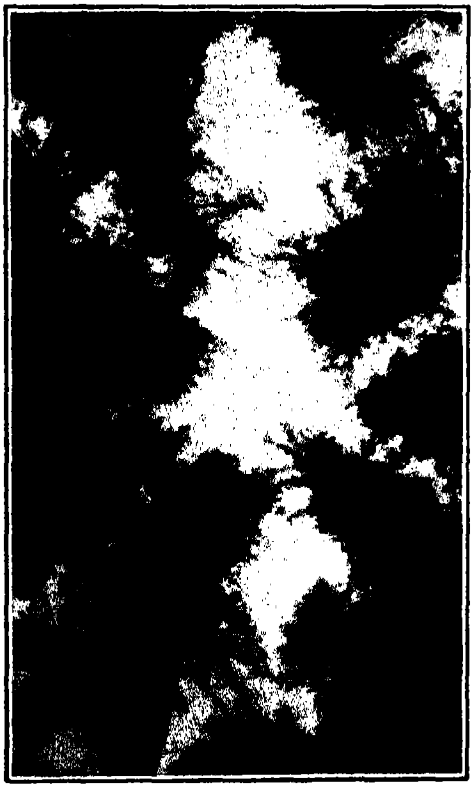

FIG. 4.—The canopy in a Redwood forest showing the sky pattern. (Photograph by Dr. A. A. Cannon.)

columns of young Redwoods. In the Big Basin, one specimen known as the Chimney Tree is a hollow trunk 100 ft. high, in which several people can stand and look upwards to the sky through the open end: the wood has been almost completely destroyed by fire; the shell still bears many vigorous branches.

On many of the trees are large and small burls, rounded excrescences like great warts, which are sold as souvenirs; when sawn off and placed with the flat surface in a saucer of water and wet moss, the dormant buds grow into an encircling wreath of two-ranked foliage-shoots.

It was not until we came to Scotia that the preserved areas were seriously interrupted by hill-sides bare of all but charred stems and comparatively young trees which had grown from the roots of felled parents: the older trees were being sawn in the mills of a lumber company into huge planks.

The Redwoods appeal to us by their superbly fashioned columns, impressive examples of perfect architectural construction, bearing tapering cones of massed branches (Fig. 3); tree separated from tree in the distant canopy by small fringed spaces open to the light of the sun and to the sea fogs from the west (Fig. 4)*. They make an appeal as living things—some of them have been growing where they stand for twenty to thirty centuries—linking the present with a prehistoric past: groups of trees already centuries old surrounding ancestral relics bear witness to the continuity of the race through ages still more remote. At Calistoga, seventy miles north of San Francisco, one sees striking examples of petrified Redwoods, more than 100 ft. in length and 8 ft. in diameter, in beds derived from some Pliocene volcano, and with the stems have been found cones and foliage indistinguishable from those of the living species. It is easy to visualise a continuous series of generations linking the present with the latter part of the Tertiary period. In places where a Redwood climate prevailed, there is no reason to assume any substantial change in the forest flora of western America through the many thousand years of this small fraction of geological history. Nor, as we shall see, is there any evidence of essential difference between the Redwoods and their forest associates and the trees and shrubs which lived in California and Oregon in the middle of the Tertiary period, say fifty million years ago.

From an intensive study of some of the older Tertiary floras in Oregon, Prof. Chaney has shown that the striking contrasts revealed by a comparison of the Oligocene and recent floras of Britain are not found in western America. The Oligocene and Miocene plants described by Prof. Chaney were collected from localities in the John Day basin a little to the east of the centre of Oregon (see Fig. 2). Two of the floras—the Bridge Creek flora of Oligocene age and the Miocene Mascall flora—suffice to illustrate the appropriateness of the application to the Redwood flora of the phrase, 'the past in the present'. These floras have much in common but the elements of the Mascall flora indicate less humid conditions and greater exposure to light. More than 20,000 specimens from the Bridge Creek beds were examined and tabulated; and for comparison 8000 specimens of leaves, twigs and other scraps gathered from contemporary stream deposits in a canyon in one of the preserved areas (Muir Woods), where sediment is being deposited at bends of the river. In the Bridge Creek flora there are four dominant species, *Sequoia Langsdorfii*, *Alnus carpinoides*, *Quercus consimilis*, *Umbellularia* sp., which make up 86·44 per cent of the whole: in the recent stream

* I am indebted to Dr. A. A. Cannon of Stanford University for the photographs reproduced as Figs. 3 and 4.

deposits the corresponding species, *Sequoia sempervirens*, *Alnus rubra*, *Quercus densiflora*, *Umbellularia californica* constitute 85·44 per cent of the total number of species.

It is customary to speak of the Tertiary *Sequoia* with two-ranked leaves as *S. Langsdorfii*; but it may well be specifically inseparable from the existing Redwood. The plants of the Mascall flora are preserved in diatomaceous shale above the Bridge Creek beds and separated from them by sheets of lava. Several trees, such as species of *Quercus*, *Sequoia Langsdorfii*, *Umbellularia*, *Salix*, *Acer*, *Cornus*, *Rhus*, *Cerocarpus*, and many others have representatives in the Redwood forests, while there are several other plants which have their modern counterparts in eastern America and elsewhere. The resemblance of the Bridge Creek flora to that of the present Coast Range forests is much closer: among conifers *Pinus*, *Tsuga*, *Sequoia* and *Torreya* are common to both; among flowering plants *Myrica*, *Corylus*, *Alnus*, *Quercus*, *Berberis*, *Umbellularia*, *Fraxinus*, *Acer*, *Rhamnus*, *Cornus* and many others, all linking the Oligocene and recent floras by closely related species.

In the course of the gradual desiccation, since the Oligocene age, of the northern part of the Great Basin—the region through which flows the John Day River—most of the characteristic Redwood associates have disappeared from Oregon, though they have survived in the more humid belt on the western seaboard. The Bridge Creek flora, which is one of many examined by Prof. Chaney and his co-workers, is an example of an association still found in the Redwood belt; and in essentials it agrees with Tertiary floras recorded from Switzerland, Greenland, Spitsbergen, Siberia and Manchuria. We know that *Sequoia* flourished in Mid-Tertiary England, in the arctic regions as far north as Ellesmere Land, over a large area in Europe and the Far East, and in many parts of the New World. Why is the genus now confined to a narrow strip of California? No satisfying answer has been given: Prof. Chaney believes, and he is probably right, that "emergence and the consequent withdrawal of epicontinental seas have played an important part in the restriction of the Redwood forests".*

It is impossible in a single article to do more than direct attention to the nature of the work now being done on the reconstruction of some of the Tertiary floras of the New World and their comparison with floras of the present day. From Alaska through British Columbia, Washington and the States farther south are scattered vast stores of plants waiting to be collected and described; there are also large collections in Canadian museums. This field of work is exceptionally rich in promise: it is certain that by adopting the methods so successfully and convincingly employed by Prof. Chaney, who studies the extinct side by side with the recent floras and follows the latter beyond the southern boundary of the United States into Central and South America, it would be possible to follow the development and vicissitudes of the plant-world over nearly the whole length of western North America. Abundant material is available; the workers are lamentably few.

* For fuller information on the Bridge Creek, Mascall and other Tertiary floras and their relation to the modern Redwood Forest, see R. W. Chaney's papers in Publication No. 349 of the Carnegie Institution, Washington, 1925. Also a paper in Publication No. 346, 1927.

Relations between Pure and Applied Science*

By Sir JAMES BAILLIE, O.B.E.,
Vice-Chancellor of the University of Leeds

THERE is still a certain amount of misunderstanding of what applied science means, especially on the part of those who draw a hard and fast line between pure and applied science, or of those who tend to regard applied science as of subordinate scientific interest and importance. There are some who treat applied science with a certain disparagement as being an attempt to adapt science to commercial purposes, a means of increasing wealth rather than of increasing knowledge. This attitude of mind is not perhaps so widespread as it used to be, but it still exists in Great Britain. Institutions such as the younger universities, which from the first seriously took up investigations which fall within the scope of applied science, have on that account been held to have derogated from the traditional conception of universities. Certainly up to recent years in Great Britain, no such problems were considered to deserve the attention of the academic mind. It was in fact for long held to be a recommendation and a merit that universities only taught and investigated subjects which could be studied in order to acquire knowledge for its own sake, and were useless otherwise except as promoting mental discipline.

It is instructive to observe that this narrow and indefensible outlook on knowledge is changing, and that the older universities are now taking a prominent and leading part in the advancement of applied science. We have only to recall in this connexion the important investigations carried on in both the older universities in the department of agriculture, and the work done in Cambridge to solve the difficult practical problems of cold storage. The institution, a few years ago, of the Department of Scientific and Industrial Research with its corollary, the setting up of the industrial research associations, is rapidly modifying and

* From a paper entitled "Applied Science in Yorkshire" read before Section L (Educational Science) of the British Association at York on Sept. 5. In addition to the extracts here printed, dealing with the relationships between pure and applied science, the paper outlined the development of technical instruction of all types in Yorkshire, and the work of the three industrial research associations which have their headquarters in the county, as well as that of special departments instituted in the Universities of Leeds and Sheffield to promote particular industries.

will in time completely transform the former attitude of the public and academic mind to applied science. When the history of universities in Britain comes to be written, it will be found that not the least of the contributions made by the younger universities to the development of academic life is that they led the way in recognising the scientific value and interest of applied science.

Applied science is neither more nor less than an investigation in the laboratory of the processes which are involved in the adaptation of Nature to the service of society in one form or another—a purpose which is surely eminently important and desirable. Some of these processes have been carried on empirically and with relative success for generations, to the great advantage of mankind. A large amount of experience has been accumulated and handed on by tradition, custom and instruction; but such experience has not been critically examined in the light of and by means of scientific method and resources. So far as rules have been arrived at in this way, the experience acquired rests on what we may call rule of thumb. The purpose of applied science is to substitute the rule of scientific law for the rule of thumb.

In other cases the laboratory examination of Nature's processes and material may lead and has led to the discovery of ways and means of adapting Nature to man's service in directions which have not been thought of in the past. In these cases the knowledge of the laws discovered by science precedes the adaptation of Nature's resources to man's use. New industries and manufactures may arise as the result of the antecedent work of the scientific investigator. Even here it must not be assumed that the application of science ceases to be science when the science is applied. The application consists in carrying out in detail the general laws discovered by science; and this in principle is in no way different from the process of verification by practical test which is an essential characteristic of scientific method. In other words, the application of science is a process of science as much as the discovery of the laws which are applied for man's service. Whether, therefore, the process of using Nature for man's ends precedes investigation by the scientist, or scientific investigation precedes and gives rise to the application of Nature to man's ends, is merely a matter of history and does not affect the meaning of applied science.

Applied science is thus quite distinct from the industrial and commercial development of the results of scientific investigation. This development depends on other considerations;—whether the capital is available to commercialise the results, whether anyone has the imagination and resourcefulness to produce an article which will appeal to the public, or whether the adaptation of the results for the use of man is economically profitable at a given time. Faraday's discovery of magnetic induction was of immense potential service to man, but it required time and genius of another order than his to foresee the ways and means to make it available for man's convenience.

Applied science does not differ from pure science by presenting a less difficult problem or by being less scientific than pure science. The sole differentia is that in the former case the results can promote man's desire to bend Nature to the service of the social life of man, while in the latter there is no such reference, at least directly or in the mind of the investigator while carrying on his investigation. The one aims at the active control of Nature, the other at the reflective comprehension of Nature. Both are essential to the fulfilment of man's life, and equally important ways of manifesting the supremacy of mind over Nature on which civilisation rests. Neither is subordinate to the other; and, as experience shows, they reciprocally assist one another, just as any science may produce results of value to another science. Sometimes we find that discoveries in pure science lead to new developments in applied science; sometimes achievements in applied science give suggestions for further investigations in pure science. Indeed there is no pure science, however apparently remote from social welfare, which may not in the long run promote the aim of applied science.

Apart from the fact that it is important to make clear the significance of applied science, the foregoing statement has a direct bearing on the subject with which the paper deals. For the development of applied science in Yorkshire has been governed by the recognition that effective control over Nature's processes, whether carried on in established industries or not, can only be secured by scientific investigation in the strictest sense. In the universities of Yorkshire in particular, applied science and pure science departments have been established from the first alongside one another. This has not been a mere accident, but a settled policy which, for the reasons given, must be considered to be as sound in principle as it has been fruitful in its results, both to the students of science and to those engaged in scientific investigation. The same policy has been adopted in the case of the higher technical colleges in Yorkshire, for example, those of Bradford and Huddersfield, where good work has been done not only on behalf of applied science but also in pure science.

No doubt in the early stages of the history of applied science in Yorkshire primary importance was attached to the practical usefulness of science for technical processes rather than to pure science. The practical mind of Yorkshire was inclined in the first instance to appreciate science for its value in furthering an intelligent interest in the productive industries of the area. This was but natural and not unreasonable; and since those concerned for the promotion of industrial welfare by means of science were, in general, not themselves trained in science, but had heard of or foreseen its value, it was perhaps inevitable that

the conception of applied science was understood in a comparatively narrow sense, as investigation and instruction in the craft side of industry and in the scientific subjects which seemed relevant thereto. The craft side is certainly an essential aspect of applied science, and must always be so if science is to be applied at all. It was only later and rather slowly that it was realised that this aspect merely sets the problem of applied science and that the understanding of the craft does not provide a solution of the questions which industrial processes raise. Still, even this humble beginning gave the start to what has provided a vast scientific undertaking.

The establishment of the Universities of Leeds and Sheffield, which represents the culminating point in the institutional development of applied science in Yorkshire, created new standards and a new outlook in the conception of applied science and its value for industry. Hitherto, applied science in the widest sense had been restricted to the communication of information on and the study of the technique of industrial processes carried on in the area, with some instruction of a rather elementary kind in certain of the pure sciences. The aim was to train or provide craftsmen with an intelligent appreciation of the rules and operations of their respective crafts, so that there might be in industry more competent and efficient workmen. With the advent of the universities and the spirit of detached scientific inquiry which inspires university work, applied science was able to become the critic and investigator of traditional industrial processes and methods, and to place the resources of a wider scientific outlook and knowledge at the service of craftsmanship. This raised instruction in applied science to a higher intellectual level. It could not be merely the communication of traditional knowledge acquired by experience in industry; its aim was not simply to confirm but to transform existing practice in industry by training whole-time students in scientific principles and by promoting scientific investigation of industrial processes. This could not but be to the ultimate advantage of industry though the effects might not be seen for some time and the results might be slow in appearing.

The prosecution of applied science at this higher level had a further important consequence; it suggested and indeed created a graded system of technical training and education with craft instruction in its various forms at one end of the scale and specialised scientific investigation into industrial processes at the other. The first could be appropriately taken over by the technical colleges, the second by the universities. There is at points a certain overlap, perhaps inevitable, between the work of the technical colleges and the universities. But the main distinction is clear between the purpose of the two types of institutions occupied with applied science. The primary business of the technical college is to provide craft teaching at a lower or a higher level, with higher scientific instruction and research occupying relatively a second place in the work of the college; the main purpose of the university is to provide higher teaching in science and to carry on scientific investigations in applied science, with technical instruction occupying relatively a secondary place in its work.

Obituary

SIR BERNARD MALLET, K.C.B.

SIR BERNARD MALLET, whose death on October 28, at seventy-three years of age, we regret to record, was the son of Sir Louis Mallet, a distinguished civil servant. He first entered the Foreign Office, from which he was transferred to the Treasury. He became a commissioner of Inland Revenue in 1897 and Registrar General in 1909, from which post he retired in 1920. His chief assistant for many years was Dr. Stevenson, who did such admirable statistical work in connexion with *inter alia* the differential birth rate, labour which never received adequate reward from the Government in spite of the loyal advocacy of his chief. Sir Bernard was president of the Royal Statistical Society in 1916–18, where, as everywhere, his personal influence was most valuable. He was for long an official of the Political Economy Club, and at its dinners must have met every living economist of note. He wrote several books, including a continuing series on the British budgets.

During the last years of his life, eugenics and the cognate subject of population occupied much of Sir Bernard's time. As to the latter, he was president of the World Population Conference held at Geneva in 1927, as a result of which was inaugurated the International Union for the Scientific Investigation of Population Problems, a now flourishing organisation in which he has continued to play an active part. He was a member of the International Federation of Eugenic Organisations, and attended meetings at Paris, Munich and in Dorsetshire. This last was somewhat of a novelty, the head-quarters being at the house of his cousin, Capt. Pitt-Rivers. A paper by him was read at the International Congress at New York this year.

Sir Bernard joined the Council of the Eugenics Society in 1918 and became its president in 1928. About that time the Society received a large bequest from an Australian pastoralist, the exaggerated hopes thus aroused in truth causing no small trouble. The Society prospered greatly under his guidance, the progress made in regard to sterilisation being especially noticeable, whilst several new schemes were set on foot, of which the most noteworthy was the attempt to give practical definition and expression to the concept of negative eugenics both in the sphere of hereditary

diseases and in that of the so-called 'Social Problem Group'.

That characteristic of Sir Bernard Mallet which will have stamped itself most strongly on the minds of all his friends is the charm of his personality. He was a gentleman in the very highest sense of the word. He was always courteous and most helpful to his colleagues. Eugenics as an applied science demands not only theoretical knowledge but also the power to judge between conflicting human motives, needs and prejudices, with the result that the task of its leaders is at times one of extreme difficulty. The Eugenics Society was fortunate in securing the services of a president with such varied experiences, all of which helped him to fill with success the place which he only consented to occupy out of a sense of duty.

PROF. K. K. GEDROIZ

SOIL investigators all over the world will learn with deep regret of the death on October 5 of Prof. K. K. Gedroiz of the Dokuchaiev Soil Institute, Leningrad, and until lately president of the International Society of Soil Science. He was born in 1872 in Bessarabia, was educated in Kief and graduated in 1897 as a forest engineer at the School of Forestry in Leningrad. He then became assistant to Kossovitch at the Agro-chemical Laboratory of the Ministry of Agriculture. In 1915 he was appointed editor of the Russian *Journal of Experimental Agriculture*, and in 1919 was made professor of soils at the School of Forestry: later on, in 1922, he became lecturer in agricultural chemistry at Nossov, and after Glinka's death in 1928 he was elected a member of the Russian Academy of Science and director of the Dokuchaiev Soil Institute, where he was specially concerned with the laboratory investigations of the soil and also with the soils of the podsol zone.

Prof. Gedroiz for many years carried out important investigations on the process of absorption by soil, attributing it, as van Bemmelen had previously done, to complex reactive substances produced by weathering. Both in their composition and their interaction with dissolved salts these substances were generally so similar in type that he felt justified in speaking of a reactive 'soil complex' modelled on the same lines as a salt, in which the cations could be replaced by other bases or by hydrogen. In the 'complex' of a normal fertile soil the predominant cation is calcium; in other soils it might be sodium, magnesium or hydrogen. In developing these ideas he was able to give a rational explanation of many of the phenomena associated with acid and alkaline soils, and to clear up many obscurities in what had previously been a very difficult subject.

Prof. Gedroiz's work was long unknown to British and American investigators owing to its publication in Russian. A summary issued in an abstract journal attracted the attention of one or two United States soil workers and they arranged for a translation of all of his papers into English. The volume was widely circulated among other soil investigators and at once ensured the recognition of the high merits of his work.

Gedroiz did much to make Russian soil science famous throughout the civilised world. His investigations into the soil complex and the phenomena of absorption fell easily into line with the studies on soil formation and classification initiated by Dokuchaiev and continued by a group of brilliant successors, Glinka, Neustruev and other workers still surviving: it gave a new and permanent direction to soil science. Gedroiz was of a modest and retiring disposition, rarely appearing at scientific gatherings: many soil investigators who visited Russia in 1930 were disappointed that they were unable to meet him and pay their respects to him. His work had sterling qualities which will ensure its place among the classics of modern science. E. J. RUSSELL.

DR. WILLIAM GARNETT

THE death of Dr. William Garnett on November 1, at the ripe age of eighty-one years, will cause a feeling of the very deepest regret to those of his contemporaries and coadjutors who knew and appreciated the man and his genius.

Dr. Garnett was born at Portsea on December 30, 1850, and was the son of William Garnett of that town. He received his early education at the City of London School, and continued it at the Royal School of Mines, having taken the first place among the Whitworth scholars in 1869. He afterwards proceeded to St. John's College, Cambridge, of which he was later elected a fellow, having been bracketed fifth wrangler in 1873. He was the first demonstrator of physics in the Cavendish Laboratory under James Clerk Maxwell, whose biographer he became.

Fortunately for the cause of technical education, Dr. Garnett left Cambridge and associated himself with the developments of education which were then taking place. He was exceptionally well qualified to take up the position of a leader in the movement which was then developing throughout the length and breadth of the country for the advancement of what was termed 'technical education'. He held the position of professor of mathematics, physics and mechanics at University College, Nottingham, and later became principal and professor of mathematics in the Durham College of Science, Newcastle-upon-Tyne. Here he did splendid work. Realising that it was most important to associate the educational authorities with the development of technical education, he to some extent laid on one side his teaching duties at Newcastle-upon-Tyne with the view of obtaining an association between his college and the education authorities. He likewise found time during this period to write on behalf of technical education in the *Technical World* and other journals.

It was only natural, therefore, that Dr. Garnett

should be appointed secretary and educational adviser to the London County Council Technical Education Board in 1893. In this position, he probably achieved his most important work. He was largely responsible for the development of the London polytechnics and worked in harmony with both the City Parochial Charity Trustees and the great City companies. When the old Technical Education Committee was superseded by the London County Council Education Committee, Dr. Garnett was appointed educational adviser, and although this position relieved him of the responsibility of much educational routine, he exercised a great influence.

Dr. Garnett had a personality which was felt by all who were brought in contact with him. In his presence, none could fail to realise that they were dealing with a man of force of character, ideals and originality. He had, moreover, the power of inspiring devotion in those with whom he was associated. J. L. S. H.

WE regret to announce the following deaths:

Prof. U. S. Grant, professor and head of the Department of Geology and Geography at Northwestern University, Evanston, Illinois, who has done much work in economic and petrographic geology, on September 21, aged sixty-five years.

Prof. A. B. Hill, emeritus professor of hygiene and public health at the University of Birmingham, president of the Society of Medical Officers of Health in 1911–12 and of the Association of County Medical Officers in 1917–1924, a leading authority on national public health, on November 5, aged seventy-eight years.

News and Views

Royal Society Medallists

HIS MAJESTY THE KING has approved of the following awards this year by the President and Council of the Royal Society in respect of the two Royal Medals: A Royal Medal to Prof. R. Robinson, for his distinguished work in organic chemistry; A Royal Medal to Prof. E. Mellanby, for his distinguished work on dietary factors, especially in connexion with rickets. The following awards of medals have also been made by the President and Council: Copley Medal to Dr. G. E. Hale for his distinguished work on the magnetic field of the sun; Rumford Medal to Prof. F. Haber for his distinguished work in the application of thermodynamics to chemical reactions; Davy Medal to Prof. R. Willstätter for his distinguished researches in organic chemistry; Darwin Medal to Dr. C. E. Correns for his distinguished researches in genetics; Buchanan Medal to Prof. T. Madsen for his distinguished theoretical and practical work on immunity, especially in relation to diphtheria antitoxin; Hughes Medal to Dr. J. Chadwick for his distinguished researches on radioactivity.

Barnaba Oriani, 1752–1832

THE centenary falls on November 12 of the death of the eminent Italian astronomer, Barnaba Oriani, who for many years was director of the Milan Observatory, and to whom Piazzi communicated his discovery of the minor planet Ceres. Piazzi first observed the planet on January 1, 1801, and a few weeks later he wrote to Oriani and Bode, the former of whom calculated its orbit. Oriani was born near Milan on July 17, 1752, and was educated by the Barnabites. He was made a priest at the age of twenty-three years and almost immediately entered the Observatory, which had not long since been founded at the College of Brera, Milan. He soon attained a recognised place among Italian astronomers and was among the first to publish tables of the planet Uranus, discovered by Herschel. In 1786 he was sent to London to obtain instruments from Ramsden. At this time he became acquainted with Herschel, with whom he afterwards corresponded. With his colleagues, Francesco Reggio (1743–1804) and Angelo Cesaris (1750–1832), he carried out geodetical operations in northern Italy. He published various works on the motion of the planets. Although, during the greater part of Oriani's life, Milan formed a part of the Austrian dominions, it was seized by the French in 1796, and in 1802, the year in which Oriani was made director of the Observatory, it became the capital of the Cisalpine republic, with Napoleon as first president. On this occasion, it is said, that on Oriani's refusing to take the oath swearing hatred against monarchy, the wording of the oath was accordingly altered for him. Oriani's successors at Milan have included Carlini, Schiaparelli and Celoria.

Atomic Projectiles

ATOMIC projectiles and their applications formed the subject of the nineteenth Thomas Hawksley lecture delivered by Lord Rutherford on November 4 before the Institution of Mechanical Engineers. At present the maximum velocity that can be communicated to matter in bulk is not more than two miles a second. This is of the same order of magnitude as the average speed of the molecules of gases under ordinary conditions. But if we turn to individual charged atoms, methods have been developed which enable us to produce atomic projectiles moving with enormous speed. When the velocity becomes comparable with that of light, we have to take into account the change of mass of the particle with speed. As the velocity is generally produced by the acceleration of the particle in an electric field, it is convenient to speak of a thousand-volt particle, meaning thereby that the particle has the speed and energy equal to that gained in passing freely between two points differing in potential by a thousand volts. In the experiments of Cockcroft and Walton in the Cavendish Laboratory, Cambridge, a steady difference of potential up to 600,000 volts can be

maintained in the accelerating tube, thus producing a stream of swift protons corresponding to a current of 20 micro-amperes. By the multiple acceleration of charged atoms, Lawrence and Livingston in California have been able to obtain a stream of protons of energy so high as 1,200,000 volts by the use of a voltage so low as 4,000 volts.

Effects of Atomic Bombardment

IN the second part of his address, Lord Rutherford described the applications of atomic projectiles. After considering the way in which swift α-particles from radioactive substances have been used for throwing light on the dimensions of the atomic nucleus, he gave an interesting account of experiments on the transmutation of matter. This has been effected by the bombardment of matter by swift atomic projectiles of different kinds. In 1919, Rutherford was able to demonstrate the disintegration of the nitrogen nucleus as a result of a close collision with an α-particle in which a swift proton was expelled. The discovery of the 'neutron' followed upon experiments by Bothe, who observed a very penetrating type of radiation when beryllium was bombarded by α-particles. Chadwick carried out further experiments by counting methods, and concluded that the radiation consists of a flight of material particles which are supposed to be close combinations of a proton and an electron. Within the last year, Cockcroft and Walton have obtained definite evidence that certain atoms can be transformed by a stream of fast protons produced artificially in a discharge tube. This new method of attack, so successfully begun, is certain to give us much new information on the structure of nuclei and the problem of the transmutation of the elements.

Egypt and the Nile

THE presidential address delivered by Sir Murdoch Macdonald to the Institution of Civil Engineers at the first meeting of the session on November 1 was almost entirely devoted to a consideration of the engineering development of Egypt and the Sudan, with which his life work has been closely associated, and, in particular, to the measures taken to bring into cultivation vast areas of waste land which have lain unproductive for centuries. Of the 360,000 square miles over which the King of Egypt rules, 95 per cent is desert. The combined area of the two cultivated districts of Lower and Upper Egypt is only about 12,000 square miles, one tenth of the area of Great Britain and Ireland; and the narrow strip of cultivated land, running for some 550 miles on each side of the Nile from Cairo to Assuan, has an average width of not more than 6 miles. Referring to the geological history of the country, Sir Murdoch said that, on the supposition that the Delta of the Nile lay in an ancient bay of the Mediterranean now filled with silt, the original mouth of the river was at Cairo. The depth of silt and sand in that locality indicates that the river once ran at a much lower level than it does now. From records of water levels on the Roda gauge, near Cairo, extending over many hundred years, it has been deduced that the bed of the river and the general level of the cultivable land must have been raised at the rate of 1 mm. a year and the process has been going on probably for 20,000 years.

Irrigation Schemes in Egypt and the Sudan

AFTER alluding to ancient indigenous methods of providing water for crops, Sir Murdoch Macdonald proceeded to discuss the modern system of perennial irrigation (under which provision has also to be made for drainage) adopted in consequence of the introduction of cotton cultivation by the Khedive, Mohammed Ali. The first work of construction in that connexion was the Delta Barrage, completed in 1861, but, owing to defects in the foundations, not brought into effective use until the British occupation, when the works were strengthened. The succeeding structures of the same type at Assuan, Asyut, Esna and Nag Hammadi were historically noticed, and then reference was made to various schemes put forward from time to time for impounding the water of the Blue Nile and the White Nile above Khartoum. Figures were quoted to show the benefit to Egypt of the Assuan Dam. The 1,000 million cubic metres of water originally impounded would be increased by the re-heightening to at least 4,800 million cubic metres and the normal summer supply would be increased by about 66 per cent. The contemplated Gebel Aulia reservoir would contain about 3,000 million cubic metres and would possibly be able to pass 2,500 million into the river. A Lake Albert Dam, only 8 metres in height, would impound about 40,000 million cubic metres, but would require to be coupled with works which would conserve the waters as they passed down the river and prevent their being wasted as at present in the Sudd region. Sir Murdoch touched upon the schemes put forward for preventing the immense loss of water due to evaporation from the marsh formed by the main stream between the Sobat and Bahr-el-Ghazal. The whole territory including the marsh region has an area of about 90,000 square miles and might become a wonderful timber growing country. Summing up the position between Egypt and the Anglo-Egyptian Sudan, he said that the large volumes of water passing in flood, of which Egypt can only use a small part, would make it possible for the Sudan to divert a great quantity without detriment to her neighbour. All the conceivable diminution by future reservoirs would not be sufficient to reduce the flood volume below the known requirements of Egypt for the fertilisation of its flood crops.

Telephony and Telegraphy in Great Britain

SIR THOMAS PURVES, engineer to the Post Office, contributes to the British Industries Number forming a supplement to the *Times* of November 1 an interesting article on the industries connected with telegraphy and telephony. In the earlier days of telegraphy, Great Britain was pre-eminent in the manufacture of high quality Morse and Wheatstone automatic apparatus. The very fact of the excellence

of this equipment somewhat delayed the adoption of type-printing telegraphs in Great Britain, but the whole supplies of the telegraph system are now being manufactured at home. It is hoped that the establishment of the teleprinter exchange service which is being introduced by the Post Office as an adjunct to the public telephone switching system will produce a further extensive demand for these ingenious machines. Before the year 1912, when the telephone service of Great Britain was transferred to the Post Office, a large portion of the equipment was purchased from abroad. Now the proportion of foreign material purchased by the Post Office is less than one per cent of the whole. A great impetus was given to the mass production of apparatus on precision principles in 1922 by the general adoption of standardised types of automatic exchanges. This policy encouraged other nations to follow suit and export markets to several countries were opened up for automatic telephone equipment manufactured in Great Britain. The circuits and mechanisms developed for automatic exchanges opened up independent fields of application in other directions, such as the supervisory control of electrical power plant, centralised railway control and the electrical equipment of the totalisators now operating on racecourses. Telephone manufacturers were quick to take advantage of these applications.

Telephone Development

THE economic blizzard from which the world is now suffering has affected the rate of telephone development in Great Britain to a smaller extent than in any other of the principal nations. Sir Thomas Purves states that the net increase per annum in Great Britain in recent years has been about 125,000 stations. In the last complete year (1931–32) it fell to 84,000. Nevertheless, it is the largest increase recorded in any country of the world for the same period. For the whole of Europe, outside of Great Britain, the net increase was less than 200,000. In some countries the number of cessations of service exceeds the number of new subscribers and a net loss is registered. In North America, for example, the net loss is about 550,000 stations. For the current year, it is probable that there will be a net increase in Great Britain of about 80,000 and that many of the countries of Europe will show actual losses. In America there will be a large loss. If a revival of trade occurs, the telephone development of Great Britain will go forward by leaps and bounds. In the matter of underground, telegraph and telephone cables, Great Britain has been from the first a pioneer. For building open telegraph and telephone lines it is still necessary to depend on Norway and Sweden for slow-grown raw timber. English and Scottish mountain pine and Canadian and Australian timber have proved disappointing. The use of poles of metal and concrete has been investigated on numerous occasions, but so far the cost of these alternatives has proved prohibitive. The timber used for general construction purposes is obtained entirely from home and Empire sources. The whole of the extensive radio plant and apparatus for long-distance communication used by the Post Office is of British manufacture.

Recent Developments in the Utilisation of Electricity

IN his inaugural address as chairman of the North-Western Centre of the Institution of Electrical Engineers, Mr. G. F. Sills discussed a very large number of recent developments in the utilisation of electricity. One of the most important and most promising of electric devices is the mercury arc rectifier. When supplied with direct current, it can be made to generate alternating current voltage at any frequency. It can also supply direct current when supplied with alternating current. It provides a link between a.c. and d.c. systems which works either way. Batteries can thus be used as a reserve on a.c. systems. One of the most important applications is to feed single-phase railways from a three-phase system at a different frequency. The standardisation of systems of supply for electric railways is thus not likely to lead to much trouble, as by the aid of the rectifier any kind of electric supply can be converted into any other. By its use it will soon be possible to transmit power by high-voltage direct current and this will lead to considerable economies in transmission. Obstruction lights are now being placed on power lines for marking obstacles along airways. They generally consist of neon tubes operated either at high or low voltages. They are used also to indicate high buildings and wireless masts. The light gives a large splash of red colour and is easily distinguished from other lights near the ground. Another interesting application is the reading of consumers' electric meters by means of telephone lines, the connexion being made through the power company's connexion with the telephone exchange. A device for indicating the presence of a dangerous amount of coal gas is also described. It works automatically, closing an alarm circuit, and it can be made to switch on an electric fan to clear the dangerous area.

Manufacture of Lenses

THE presidential address of Mr. W. Taylor to the Institution of Mechanical Engineers on October 28 was mainly devoted to the application of mechanical engineering to the production of lenses, particularly photographic lenses, which to-day are made by the tens of thousands. One of the characters of mechanical engineering, he said, is the extraordinary accuracy regularly attained in its best products. One thousandth of an inch is approximately the limit of accuracy which can be attained in the ordinary machining of metal with cutting tools, one ten thousandth the order of accuracy by grinding and lapping; but in making the best photographic lenses and other optical instruments of precision, the accuracy of the surfaces of the elements, such as lenses, prisms and mirrors, must be from one hundred thousandth to a few millionths of an inch, and this accuracy is attained in everyday working, not only by skilled artist craftsmen, but also by less skilled

persons doing repetition work by the aid of special appliances, the products of mechanical engineering. In the course of his address, Mr. Taylor referred at length to the functions and designing of lenses, the properties and the production of optical glass and the various workshop processes by which lenses are cut, ground, polished and tested. It was in connexion with work on photographic lenses that the need was felt for screw-threads much more accurate in form, more free from pitch and periodic error, and this in turn led to improved technique of screw-thread measurement, gauging and generation.

Andrew Laing Memorial Lecture

THE winter session of the North-East Coast Institution of Engineers and Shipbuilders was opened on October 21 by the delivery at Newcastle-upon-Tyne of the presidential address by Mr. R. J. Walker, who since 1899 has been associated with the Parsons Steam Turbine Co., Ltd., of which after the death of Sir Charles Parsons he became chairman and managing director. At the following meeting of the Institution, held on October 28, Engr. Vice-Admiral Sir R. W. Skelton, the Engineer-in-Chief of the Fleet, delivered the first Andrew Laing lecture. Laing, who was born in Edinburgh on January 31, 1856, and died in Newcastle on January 24, 1931, from 1877 until 1896 was connected with the Fairfield Shipbuilding and Engineering Co., Govan, and from 1896 until the time of his death was managing director of the Wallsend Slipway and Engineering Co. His life's work was mainly connected with the design and construction of the machinery of Atlantic liners, his most famous ship being the *Mauretania*, built in 1907, which for twenty-three years held the 'blue ribbon' of the Atlantic. The construction of this vessel and her ill-fated sister ship the *Lusitania* was due to circumstances somewhat akin to those existing to-day, when the fastest vessels in the mercantile marine are not registered as British vessels. The initial step was the formation of an Admiralty committee in 1902 which was directed to inquire into the principles on which subsidies were being given and to consider how and at what cost vessels could be secured which should combine great speed with a large radius of action. The outcome was an agreement between the Government and the Cunard Co. whereby the Government agreed to advance a sum of money at 2¾ per cent interest for the construction of two ships and to increase the annual subsidy. The bold step of adopting steam turbines for the vessels was due to the report of a technical committee on which Laing served.

Memorial to Sir Gregory Foster, Bt.

A FUND has been raised for the establishment of a memorial to the late Sir Gregory Foster, at College Hall, London, a hall of residence for women students in the University with which he was connected for more than thirty years, during twenty-one of which he was chairman of the Council. The memorial has taken the form of the provision of teak doors throughout the public rooms of the new building for the Hall recently erected in Malet Street and to be opened by H.M. the Queen on November 10. A memorial tablet designed by Mr. Brook Kitchin has also been placed in the entrance hall and bears a record of the services rendered by Sir Gregory Foster. A portrait painted by Mrs. Macleod has now been finished and has been hung in the council room of the Hall. It represents the sitter not as his friends knew him in the last years of his life, but as he will be remembered by those who knew him in the fullness of his strength and vigour, thus providing an interesting comparison with the portrait recently painted by Sir William Orpen which hangs in University College. The memorial tablet was unveiled on November 4 by Sir Alexander Gibb, who succeeded Sir Gregory Foster as chairman of the Council of College Hall. About a hundred or so of those who had subscribed to the memorial fund were present, and for the greater number of these the occasion presented the first opportunity of seeing the new building, which in itself is the greatest and most lasting memorial to Sir Gregory Foster's work in providing increased residential accommodation for the students of the University of London.

Huxley Memorial Medal and Lecture

THE presentation of the Huxley Memorial Medal of the Royal Anthropological Institute for 1932 to Prof. C. G. Seligman will take place on November 29, when Prof. Seligman is to deliver the Huxley Memorial Lecture at 8.30 P.M. Prof. Seligman is already a medallist of the Royal Anthropological Institute, having been awarded the Rivers Memorial Medal for 1926 in recognition of his work in the field in New Guinea, among the Veddas of Ceylon and in the Sudan. Prof. Seligman gained his first experience of field work as a member of the Cambridge University Expedition to the Torres Straits in 1898 under Dr. A. C. Haddon. He visited New Guinea again as joint leader of the Cooke-Daniels Ethnographical Expedition in 1904, publishing his results in "The Melanesians of British New Guinea" (1910). His studies of the Veddas in 1907, in which he was assisted by Mrs. Seligman, were published as "The Veddas" in 1911, while the results of his investigations among the Sudanese tribes on several occasions, on which he has again been accompanied and assisted by Mrs. Seligman, are announced for publication at an early date. The study in the University of London of the customs and races of man has made substantial advances during Prof. Seligman's occupation of the chair of ethnology at the London School of Economics, especially in the promotion and organisation of training for colonial officials.

Scientific Expedition to Tibet

IN February 1933 Capt. F. Kingdon-Ward is setting out to explore what is perhaps the least-known part of Tibet—the arc of mountainous country which lies between the bend of the Tsangpo-Brahmaputra and the bend of the Salween. The route to be followed is: the Assam valley, Sadiyà, Lohit valley, Rimà, up the Rong Thod Chu, over the Ata Gang Pass (16,000 ft.)

to Shurdin Gornpa, in lat. 29° 30′ N., long. 97° 0′ E., where a base camp will be established at 13,600 ft. altitude. From here the collecting work will be done. This is the cross-roads of Asia, the meeting place of four floral regions, the Central Asian, Sino-Himalayan, Indo-Malayan, and Eastern Asiatic; and it harbours the richest alpine flora in the world. The flora of this area should in fact throw light on both the earlier east and west distribution of plants across south-eastern Asia, and on the later north and south distribution, down the Malay Peninsula, brought about during the last glacial epoch. The predominance of the former is difficult to account for if we assume the Himalayan uplift to stop short at the Tsangpo bend, or to curve southwards at this point. On the other hand, if the Himalayan axis is prolonged eastwards, the Salween River must cut across it in a very deep gorge, and should moreover cross at a point of maximum elevation, precisely as the Indus and Tsangpo do. These are matters for investigation. Thus both botanical and geographical work will be done. These are closely related, and each illuminates the other. The botanical collecting will be done on behalf of the Department of Botany of the British Museum.

Weather Information to Aviators in India

THE India Meteorological Department has set out a complete account of the arrangements in force for the supply of reports on existing weather and of anticipated weather to aviators flying over any part of an immense area which includes not only India but also the Persian Gulf coast east of Bushire, Baluchistan and Burma (India Meteorological Department. Meteorological Organisation in India for the Supply of Weather Information to Aviators. Pp. iii+27. (Calcutta: Government of India Central Publication Branch, 1932.) 12 annas; 1*s*. 3*d*.) There are five main forecasting centres, at Karachi, Calcutta, Poona, Peshawar and Quetta. The first three centres are organised with a view of issuing reports and forecasts to civil aviators, and the last two deal mainly with the requirements of the R.A.F. The local centres also number five, namely Rangoon, Akyab, Dum Dum, Allahabad and Jodhpur. There would normally be available at such local centres information about the force and direction of the wind up to a height of 10,000 feet. There is another type of distributing centre—the pilot balloon station—of which there is a relatively large number. These are aerodromes or landing grounds with observers who make soundings of the upper atmosphere with pilot balloons, and are able to supply the information about upper winds so obtained to aviators on request, and presumably are also largely responsible for supplying such local information on this subject as is required at the more important centres. The information given in this pamphlet appears to include everything that can possibly be required by aviators, including the times of issue of the regular broadcasts, all necessary codes, and the wave-lengths, together with detailed instructions as to the procedure for obtaining special reports while in flight.

Galvanometer Mirrors for Sound Recording

IN the variable width method of recording sound on film, a galvanometer is used in which a loop of metal ribbon, 0·005 in. broad and 0·0005 in. thick, is placed between the poles of a permanent magnet, a small mirror being cemented across the two arms of the loop. When speech currents from the microphone and amplifiers pass along the ribbon, the mirror vibrates and causes the reflected beam of light to traverse a narrow slit at right angles to the direction of motion of the film, and thus trace a graph of the sound waves. Since the upper limit of reproduction from the ordinary talking film projection apparatus is about 6000 cycles per second, the natural frequency of oscillation of the galvanometer must be at least as great as this. The inertia of its moving parts must, therefore, be low. The mirror must be as light and small as possible. It should also be accurately surfaced and silvered in order to ensure uniform reflection. The production of such mirrors is an interesting piece of optical work involving manipulative processes on a different scale from that employed for the usual products of the manufacturing optician. Mirrors made by Messrs. Taylor, Taylor and Hobson, Ltd., Stoughton Street Works, Leicester, specially suitable for these galvanometers, are rectangular in shape and measure 0·032 in. by 0·018 in. by 0·004 in. The glass from which they are made is first cut to the correct size and then optically worked on both sides. The back surface is silvered by cathode sputtering and is protected by a suitable varnish. The finished mirror weighs 0·0001 gm.

Memorial to Laplace

L'Astronomie for September contains a panegyric on Laplace, delivered by Dr. E. Esclangon, director of the Paris Observatory, on the occasion of the unveiling of a statue of the famous astronomer at Beaumont-en-Auge on July 3. Dr. Esclangon observes that Laplace is justly called the French Newton; while basing his work on Newton's law of universal gravitation, he carried the results of this law very much further than any of his predecessors. Special mention is made of his detection of the cause of the lunar acceleration arising from the diminution of the eccentricity of the earth's orbit. He also made useful researches on the theory of the tides; and his famous nebular hypothesis, though no longer held in its original form, at least as regards the solar system, was a valuable contribution to cosmogony, and formed the starting-point of many other theories.

Reversion in a Hybrid Macaw

WHAT appears like a very striking case of reversion in a species-hybrid is related, in the *Avicultural Magazine* for September, p. 220, by A. Anderson, who describes a hybrid macaw bird in New Zealand this year between a male of the red-and-yellow and a female of the blue-and-yellow species. As one parent is red and the other yellow below, it is not surprising that the hybrid young bird shows both

these colours on the under-surface; what is strange is that the back is bluish-green, for the male is red here and the female blue, so that the green tint must be due to a return to a coloration ancestral in macaws, most of which are as a matter of fact green, though the more sensationally coloured species are those familiar in captivity. The case is similar to the appearance of a rufous-coloured and more ordinary bird resembling Hume's pheasant when the copper-red, white-pied Elliot's pheasant has been crossed with the Mikado pheasant, which is mostly black, and to the production of sheldrakes showing much smoky-grey pencilling similar to that on the Australasian farms when the rufous South African grey-headed sheldrake was crossed with the mainly-white European species, in both cases a more primitive and plain coloration appearing.

Announcements

THE following awards have been made by the Royal Aeronautical Society: Taylor Gold Medal to Dr. G. V. Lachmann for his paper entitled "Control Beyond the Stall", and the Busk Memorial Prize to H. Constant for his paper entitled "Aircraft Vibration".

THE following appointments have recently been made by the Secretary of State for the Colonies in the Colonial Forestry Services: Mr. D. Kinloch, to be assistant conservator of forests, Gold Coast; Mr. P. C. Randell, to be assistant conservator of forests, Nigeria.

THE following is a list of those recommended by the President and Council for election to the Council of the Royal Society at the anniversary meeting on November 30:—*President:* Sir Frederick Hopkins; *Treasurer:* Sir Henry Lyons; *Secretaries:* Sir Henry Dale and Sir Frank Smith; *Foreign Secretary:* Lord Rayleigh. *Other Members of Council:* Dr. J. A. Arkwright, Prof. W. L. Bragg, Prof. C. H. Desch, Dr. G. M. B. Dobson, Mr. A. C. G. Egerton, Dr. J. Gray, Prof. A. V. Hill, Prof. A. Hutchinson, Prof. J. E. Littlewood, Prof. E. Mellanby, Prof. R. Robinson, Dr. N. V. Sidgwick, Prof. A. G. Tansley, Prof. D'Arcy W. Thompson, Dr. W. Trotter, Mr. G. Udny Yule.

THE fourth of the series of exhibitions: "Photography in the Service of Mankind", at the house of the Royal Photographic Society, 35 Russell Square, London, W.C.1, will be devoted to kinematography. The exhibition will be opened on November 14 and will remain open until December 10. Much of the space available will be occupied by apparatus illustrating the historical development of kinematography and the various outstanding achievements on the mechanical side of the science. In addition to the exhibition proper, however, a series of eleven meetings has been arranged. These will illustrate, through the medium of films, the immense variety of ways in which kinematography touches modern life: salesmanship, medicine, natural history, general scientific research and education are among the subjects to be illustrated.

THE British Social Hygiene Council has arranged a national conference on "The Place of Biology in Education" to be held at the British Medical Association House, Tavistock Square, London, W.C.1, on November 30 and December 1 and 3, under the presidency of the Right Hon. Viscount Chelmsford. During the first morning session, besides the inaugural addresses of the president and patrons, the national and imperial need for a biological outlook will be considered. In the afternoon and on December 3, the promotion of the teaching of biology by local authorities and biology in training colleges, central, senior and elementary schools and in public, secondary and preparatory schools will be discussed. On December 1, a joint session will be held with the Central Association for Mental Welfare to discuss the problem of the social control of the feeble-minded child leaving the ordinary elementary school.

A CATALOGUE of an unusual sort of collection has been issued by Messrs. Dulau and Company, Ltd., 32 Old Bond Street, W.1. It contains lists of old prints in colour and line chosen chiefly for their decorative charm, and includes many items of interest to naturalists and others. Many are plates from standard works by such as Buffon, Levaillant, Pennant, Gould, at prices varying from 1*s.* to 30*s.*; hand-tinted sporting prints published between 1805 and 1807, at 35*s.* each; Loggan's copper-plate views of Oxford (1675) at 5*s.*–20*s.*; old maps, old coloured lithographs of the mansions of England by Joseph Nash (1869), portraits by Bartolozzi (1793–99), and sundry other prints making an interesting series of 353 items.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A junior assistant in the Museum and Art Gallery of the County Borough of Reading—The Curator (Nov. 12). A second engineering assistant in the Waterworks Department of the County Borough of Brighton—The Waterworks Engineer, 12, Bond Street, Brighton (Nov. 16). Examiners in practical mathematics, practical drawing and science of the preparatory senior technical course of the Union of Lancashire and Cheshire Institutes—The Secretary, 33, Blackfriars Street, Manchester (Nov. 21). A full-time assistant for electrical engineering courses at the Crewe Technical College—The Director of Education, Dept. 'C', County Education Offices, City Road, Chester (Nov. 23). Five assistant engineers in the Post Office Engineering Department—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (Nov. 24). An assistant lecturer in physics at King's College (University of London)—The Secretary, King's College, Strand, W.C.2 (Nov. 28). An instructor in manual work and engineering at the King's School, Pontefract—The Headmaster. Grocers' Company research scholars in sanitary science—The Clerk, Grocers' Company, Grocers' Hall, London, E.C.2. A lecturer in elementary electrical engineering at the Borough Polytechnic, London, S.E.1—The Principal.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Down Pelage in the Ovidæ

THE woolly covering of the adult sheep, the fleece, is often considered to differentiate the Ovidæ from other mammals, and not less distinctive is the coat of the lamb. In most breeds of sheep the lamb is closely covered with a birth coat of small spiral tufts of fibres (Fig. 1). The tufts vary in size, the number and closeness of the spiral turns and their distance apart, all of which are characters having a bearing upon the fleece grown later. In addition, long hairy fibres protrude beyond the level of the tufts and, where plentiful, partly obscure or even replace them, as over the face, the under surface and down the legs. With the later growth of the fleece the spiral tufts are carried upwards, for the most part preserving their form and distinctness (Fig. 1), maybe until the first shearing at about fifteen months. In some cases, however, small successive fragments break away at the tip, particularly in the merino, where the identity of the tuft is lost within three or four months. The coarse hairy fibres are shed within the first months of the lamb's existence, and are generally replaced by fibres of a different type.

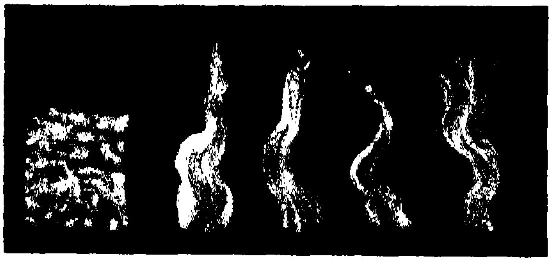

FIG. 1. Portion of skin of new-born Welsh Mountain lamb showing spiral tufts; also two-month staples of South Devon lamb with spiral tufts at apex, right staple opened out to show prototrichs.

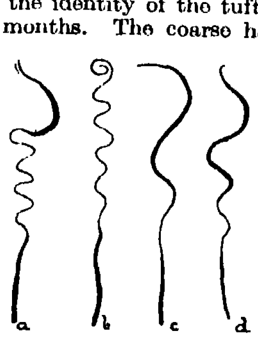

FIG. 2. Diagram of various forms of prototrichs continued into the thicker definitive fibre.

Attention has recently been directed to the constituent fibres of the spiral tufts, as possible guides to the later wool production. Different forms occur, some of which are shown diagrammatically in Fig. 2. Fig. 2*a* represents the most characteristic form. The fibre is at first sickle-shaped and thickens below the tapering tip, being medullated for a short distance. It then becomes very fine and curly before passing into the definitive fibre, which is usually thicker. The curls follow very closely the spiral turns of the tuft, as if moulded thereby. Fig. 2*b* shows another frequent form where the sickle thickening is wanting, and the whole fibre is fine and curly to the tip. All intermediate stages between the well-defined medullated sickle tip and the curly tip can readily be found, even in the same tuft, and the one can only be regarded as an attenuation of the other. The aggregate of sickle tips gives a stiff, beak-like apex to the tuft while the other has only a flat ending.

Among the coarse fibres of the belly and legs the tufts are more or less wanting and the sickle often assumes a whip-lash effect (Fig. 2*c*). Again, the thick medullated part of the sickle may, as it were, encroach to a greater or less distance on the fine part below (Fig. 2*d*) and even for the whole distance, appearing of the same thickness as the definitive fibre itself. Fibres of this character are to be found on the legs where the wool is largely replaced by coarse kemp fibres, and all transitional stages from true sickle fibres to kempy fibres are met with. Beneath the characteristic forms above described very fine short woolly fibres everywhere occur. The sickle tip of the fibres is doubtless to be associated with the fact that the new fibre does not at first emerge in a straight line with the follicle, but passes horizontally for some distance along the epidermis in the canal produced in connexion with the sebaceous gland. In general, the medullated sickle tips are followed by kemp fibres while the curly tips are continued as heterotypes and wool.

Sickle tipped medullated fibres from the birth coat of the merino were first described by me[1] and have since been found in the primitive coat of the Blackhead Persian and elsewhere,[2] while Dry has recently described both sickle tipped and curly tipped fibres from the Romney Marsh.[3] In the course of the present study they have been found on the birth coat of practically all the British breeds. Manifestly, in their different expressions, they are a truly distinctive feature of the birth coat, to be considered apart from the definitive fibres into which they are continued. It is submitted that they are best regarded as down fibres or prototrichs, comparable in many respects with the down which occurs at the apex of the definitive feathers in birds. The entire covering on the lamb at birth, the spiral tufts as well as the hairy fibres (halo fibres), would then be regarded as a down coat composed of prototrichs or down fibres, persisting for a time at the tip of the staples of the later woolly coat.

The constancy with which the medullated sickle tipped prototrich occurs suggests a phylogenetic significance. It is a fibre essentially coarse above and fine below and, having been produced *in utero*, the difference can scarcely be interpreted as a response to conditions other than those genetic in their nature. Fibres of the same differential character, which I have elsewhere termed heterotypes,[1] prevail among mammals generally. Thus mature fibres of the various mountain and long-woolled breeds among sheep show a greater or less indication of coarseness above and fineness below, to repeat itself year by year. Similar differences are found among most other domestic animals, dog, cat, horse, cattle and camel, and in the yak, jackal, seal, hare,

deer and bison. The coat tends to be coarse on the outside and fine below, but for the most part the change is effected in the individual fibre. It is manifest that heterotypism is to be regarded as the primary condition of the hair fibres in most mammals, carrying with it a physiological significance, and it is repeated in a simplified form in the down fibres or prototrichs of the Ovidæ. The curly tipped prototrichs are merely those which have lost their medullated thickening, and all stages are forthcoming from one extreme to the other, just as we have all stages towards complete medullation of the sickle fibre.

We thus arrive at the conception that the birth coat in the Ovidæ is a true down coat, a separate pelage of spiral tufts. The constituent fibres are distinct from the later definitive fibres, and are to be contrasted as prototrichs or down fibres. The stages shown by the prototrichs towards fine woolliness on one hand and coarse kempiness on the other establish the close relationship of the many different types of fibres met with in the Ovidæ (wool, heterotypes, garo, kemp) with those in other mammals where the pelage comprises gradations of only one type of fibre. The distinctive coat of the Ovidæ is brought into direct relationship with that of mammals generally; the component fibres of the two are but differentiations of a single type, even though for classificatory needs they may be grouped separately.

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[1] *J. Text. Inst.*, 18, 1927.
[2] Bull. No. 82, Dept. of Agric. S.A., 1930.
[3] Bull. W.I.R.A., vol. 2, No. 2, 1931.

Weather Maps of the World

IN connexion with the special investigations arranged for the polar year, it is proposed to collect observations from sea and land in order to obtain effective charts for the whole of the northern hemisphere and perhaps, in time, of the southern hemisphere too.

The invitation to contribute observations is accompanied by an excellent outline chart of the northern hemisphere with contours of the land surface for 500, 1000 and 2000 metres.

The charts carry also, as specimens, meteorological information for the first week of March 1931, which includes isobaric lines over the sea, continued over the land as *sea-level* isobars. The practice of drawing isobars which, over the land, are merely hypothetical, has been customary in meteorological work now for some seventy years. Perhaps it began with north-western Europe where sea level is at least a near neighbour; but it has developed until, in the proposed charts, sea-level isobars are shown over the contours of the Rocky Mountains, the Alps, the Himalaya and Greenland, although sea level has a very restricted meaning for those countries and the change in the distribution of the meteorological elements with height is a primary meteorological problem.

The enterprise is a repetition, on a more advanced scale, of one which was undertaken by the Meteorological Council in connexion with the original polar year, 1882–3. All the available information for the Atlantic and adjacent continents was collected and plotted on well-known charts, published by the Council.

Incidentally, that enterprise led to a mistrust of the closed isobars round cyclonic and anticyclonic centres as the controlling powers in weather; a mistrust which in Great Britain we have never been able to shake off. It will be interesting to learn whether the jubilee of the polar year will reconstitute them or discredit them further.

A real question about weather charts for the world turns, however, upon sea-level isobars carried over the land irrespective of its elevation above sea level. It is undeniable that, by that practice, pressure is separated from its associates temperature, humidity and wind, and the student of weather is left more or less 'in the air' while space on the map is occupied by lines without any definite meaning.

The contours on the outline charts suggest that the enterprise offers a golden opportunity for a definite step in weather study.

The contour line of 500 metres rails off the enclosures in the northern hemisphere within which sea-level isobars are ineffective. Would it not be possible to prepare the maps in the usual way for the region outside those enclosures and invite the denizens of the several regions inside: France, Austria, Switzerland, Italy and the Balkans for one, India, Persia, Russia and China for another, the United States, Canada and Mexico for a third, each to contribute a map for their enclosure that they would think most appropriate for a region above 1 km. level?

Such an opportunity may never recur; and what would be a rather questionable enterprise for an individual member of the international partnership would be real generosity on the part of each group, contributing to the advancement of knowledge for the benefit of the whole.

It might even result in changing the choice of level for charts over the sea itself, and choosing 106 metres, where the normal pressure is 1000 millibars, as suggested years ago by Köppen, for we all know that the surface is apt to mar the effective features of the atmospheric circulation.

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Oct. 24.

Heat Distribution in a Uniform Bar

THE theory of the potential distribution in a long cable when the head end is insulated after being maintained for some time at a steady potential has been given recently.[1] It was pointed out that the reasoning would apply equally well to the case of a long uniform bar which is allowed to cool after one end has been heated. The experimental confirmation of the theory is not easy in the electrical case owing to the fact that it is not possible to tap a long laid cable at intervals for the observation of the potential, and artificial lines are not available with the leakance sufficiently uniformly distributed. Moreover, the changes are very rapid, and in the practical example which was worked out in the above-mentioned paper, all transients had practically died away after the expiry of two seconds. In the heat analogue, on the other hand, the changes are very much slower and

the necessary apparatus (an ordinary 'Forbes bar') available in almost any laboratory.

In this case the expression for the temperature at any point distant x along the bar at time t after removing the source of heat is :

$$T_{x,t} = 2\,T_0\,l\sqrt{(RG)}\tanh l\sqrt{(RG)} \sum_{m=0,1,2\ldots} \frac{\cos\{(1-x/l)\,m\pi\}.\exp\left(-\dfrac{m^2\pi^2+GRl^2}{CRl^2}.t\right)}{(m^2\pi^2+GRl^2)\,(\cos m\pi+\sin m\pi/m\pi)}$$

where T_0 is the initial steady temperature at the end of the bar, R the heat resistance per unit length of bar, C the heat capacity per unit length of bar, G the rate of heat loss from surface per degree per unit length of bar, l the length of bar, and m is zero or any integer.

The bar used was of brass, and was furnished with eight holes, distant apart 10·15 cm. between centres. At one end there was a right-angled elbow joint, so

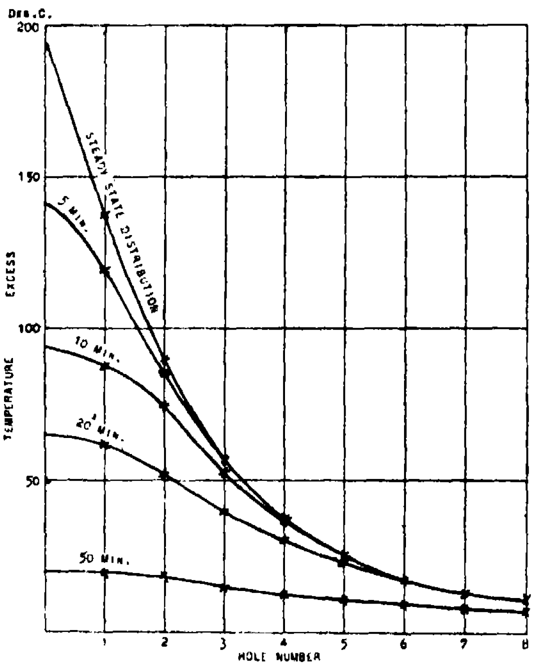

FIG. 1

that this end could be dipped vertically into a bath of molten solder while the main part of the bar was horizontal. The temperature observations were made on ordinary thermometers dipping into mercury contained in the holes along the bar. The mean distance from the centre of the first hole to the solder level was 9·4 cm. and the length of bar immersed 9·5 cm. The section of the bar was a square of 2·50 cm. side.

After keeping the end immersed for three hours in the solder bath, a uniform heat distribution was obtained and the heat source was withdrawn. The temperature at the various points along the bar was observed at regular intervals, giving the results shown in Fig. 1. This family of curves is of the same form as that obtained from theoretical considerations and shown in Fig. 1 of the paper referred to above.

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Woolwich Polytechnic, S.E.18.

Sept. 19.

[1] *Proc. Phys. Soc.*, **44**, 494; 1932.

Radiations from Radium D and E

DURING the past eighteen months, experiments have been carried out by Mr. W. J. Henderson and myself, so designed as to give us certain information about the radiations emitted by radium (D + E).

The first experiment, the initial results of which were reported at the 1931 meeting of the Royal Society of Canada, has shown that there is no evidence, in the case of radium E, for what have been called β-rays of high energy. We have used a suitable mixture of cardboard and lead, of total mass/cm.^{2} somewhat greater than the range, in order to reduce the ionisation in a cardboard-lined electroscope to one ninety-thousandth of its initial value. It is not a difficult matter to show that less than one per cent of this ionisation can be due to primary β-rays and hence that not one β-ray in 1,500,000 can belong to the group, with values of HR between 7000 and 10,000 reported by Curie and D'Espine.[1] This result gives a strong indication that β-rays of high energy are not emitted by any substance.

Henderson has examined the ranges of the β-rays of radium E in various substances and has found much larger values than previous observers. In cardboard the range is 0·52gm./cm.^{2} and in aluminium, tin and lead somewhat greater than 0·60gm./cm.^{2}. Among other things, these results indicate that if β-ray ranges are to be used to determine the end points of β-ray spectra, some convention must be adopted. One that might be useful would be to use aluminium as absorbing material and take the range as that mass/cm.^{2} which reduced the ionisation due to β-rays to one fifty-thousandth of its initial value and then calculate the end point from the data of Varder[2] on homogeneous rays. Applying this to radium E, the end point comes out at about HR = 5500. Further work is being done on this problem.

We have measured the absorption of the γ-rays in lead and have obtained estimates of the relative numbers of atoms emitting the different types of radiations, using the method of Gray and O'Leary[3]. A very soft type of γ-ray, presumably the M rays characteristic of atomic number 83, has been detected. L rays are emitted by about thirty per cent of radium D atoms and primary rays by somewhat less than four per cent, a value in fair agreement with those obtained by Bramson and Stahel and Sizoo[4]. The primary rays consist apparently of a band extending from $\lambda < 0{\cdot}28$A. to $\lambda > 0{\cdot}30$A., the average mass absorption coefficient in lead being 12. An initial attempt to detect this band by crystal reflection was unsuccessful. The bearing of our results on problems connected with the emission of β-rays from radium D will be discussed elsewhere.

The properties of the hard γ-rays of radium E are so similar to those of the X- or secondary γ-rays produced in other elements by the β-rays of radium E that I am of the opinion that they are entirely secondary in character, that is, that they are excited by some of the β-rays after their escape from the nucleus. They are emitted by about one per cent of the disintegrating atoms.

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Oct. 6.

[1] *C. R.*, **181**, 31; 1925.
[2] *Phil. Mag.*, **29**, 726; 1915.
[3] NATURE, **123**, 568, April 13, 1929.
[4] *Z. Phys.*, **66**, 721, 741; 1931.

Mercury Traps

THE interesting investigations of Messrs. Hughes and Poindexter[1] showed that a trap lined with alkali metal is as satisfactory as a liquid air trap, for preventing mercury vapour diffusing back into a vacuum system from a mercury pump. This method offers several advantages, with one disadvantage: it is difficult to clean commercial alkali metals and to avoid the introduction of various impurities (for example, organic vapours, hydrogen, carbonic dioxide) in the vacuum system. However, there exists one method —the glass-electrolysis—which enables very clean sodium to be introduced into closed glass vessels. This elegant method can be easily applied to any normal glass or pyrex glass apparatus by providing the mercury trap with an incandescent cathode and immersing it partially in molten sodium salt. We have already used a similar method in the manufacture of photoelectric cells.[2]

Mr. Ansiau, of this University, is at present experimenting with this method; the results will be recorded later.

L. MARTON.

University of Brussels.

Sept. 12.

[1] F. E. Poindexter, *J. Opt. Soc. Am.*, **9**, 629; 1924. A. Ll. Hughes and F. E. Poindexter, *Phil. Mag.* (6), **50**, 423; 1925.
[2] L. Marton and E. Rostas, *Zeit. f. Techn. Phys.*, **10**, 52; 1929.

Dispersion of Sound in Several Gases, and its Relation to the Frequency of Molecular Collisions

MEASUREMENTS on carbon dioxide, carbon disulphide, sulphur dioxide, and ethylene show that the dispersion of sound in these gases is sensitive to pressure. In each case the dispersive region shifts to higher frequencies with increasing pressures or, conversely, the velocity of sound at a given frequency increases as the pressure is diminished until a constant value is attained. At 30° C. and 451,000 cycles sec.$^{-1}$, for example, the velocity of sound is constant in carbon dioxide below about 350 mm., in carbon disulphide below about 100 mm., and in ethylene below about 40 mm. The corresponding heat capacity ratios are 1·4 for carbon dioxide,[1] 1·4 for carbon disulphide, and nearly 1·33 for ethylene; thus in each case only translational and rotational terms continue to participate in the sound wave under these conditions. In sulphur dioxide at 200 mm. the dispersion between 94 and 451 k.c. is only about 1·2 m. sec.$^{-1}$ at 30° C., indicating that frequencies above the present experimental range are necessary to demonstrate by the acoustical method that sulphur dioxide is not a linear molecule.

The temperature dependence of the dispersion of sound in carbon dioxide and carbon disulphide has also been studied. In carbon dioxide at 770 mm. the difference between the velocity of sound at 92 and at 9 k.c. is negligible at 60° C., whereas at 10° C. it is about 5·0 m. sec.$^{-1}$. Similar behaviour is manifest in carbon disulphide at about 320 mm.

The dispersion of sound in binary mixtures of ethylene with argon and nitrogen is exactly that calculated from pure ethylene at a corresponding partial pressure. It is concluded from this that the vibrational energy of ethylene is not excited by collisions with molecules of these gases. In hydrogen-ethylene mixtures, on the other hand, the effective heat capacity of ethylene rises sharply on the introduction of small quantities of hydrogen, and it is necessary to suppose that a collision with a hydrogen molecule is about ten times as likely to excite ethylene as a collision with another ethylene molecule. The analogy of this result to recent chemical evidence on the decomposition rates of the ethers is striking.

Because air, nitrogen, argon, propane, and pentane appear to be without dispersion (+0·2 m. sec.$^{-1}$) between 9 and 451 k.c. in the same apparatus it is believed that the measurements reported above are free from serious errors due to tube effects.

A quantitative description of the dependence of the dispersion of sound on pressure, temperature, and frequency has been obtained by incorporating in the dispersion theory of Einstein[2] the suggestions of Herzfeld and Rice[3] and of Heil[4]. If it is supposed that equilibrium between translational and internal energies is incomplete in high-frequency sound waves (H and R) and that only molecules of exceptionally high translational energy can excite molecular vibrations (H), an expression results which closely resembles that given by Einstein (and consequently that of Kneser[5] but which involves two additional constants. The first may be called the collision energy, and determines the temperature coefficient of the dispersion of sound much as the activation energy determines that of a chemical reaction rate. The second is dimensionless, and represents the fraction of collisions possessing the collision energy which result in vibrational excitation. For carbon dioxide these quantities are respectively about 4×10^{-13} ergs and 0·01. These magnitudes may be understood when it is remembered (Heil) that on collision less than half of the translational energy may be converted into vibrations, and that the type of collision necessary to excite a transverse vibration must be directionally extremely specific.

It is possible that a small potential energy wall may also impede the energy transfer. The two constants cannot be separated without assumption if more than one vibrational state of the molecule contributes to its heat capacity. Under these conditions a fine-structure should appear in the absorption band or, conversely, points of inflection should be manifest in the dispersion. These may be studied at constant frequency by lowering the temperature or pressure in the dispersive region.

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JAMES A. REID.

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Princeton, N.J.

[1] In agreement with Kneser, *Ann. Phys.*, **11**, 777; 1931.
[2] *Sitz. ber. Akad.*, 380; 1920.
[3] *Phys. Rev.*, **31**, 691; 1928.
[4] *Z. Phys.* **74**, 31; 1932.
[5] *Ann. Phys.*, **11**, 761; 1931.

Spectrum of Trebly Ionised Lead

THE spectrum of trebly ionised lead, which has been studied by several authors ending with S. Smith[1], requires modification in several respects. I have shown that $7p\,^2P - 7d\,^2D$ is really $7p\,^2P - 8s\,^2S$ and confirmed this by obtaining further combinations with the $8s\,^2S$ term. This provides a series of ^2S terms the values of which can be accurately calculated by Hicks's formula. $6s\,^2S$ comes out equal to 340180, giving an ionisation potential of 41·9 volts.

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Oct. 12.

[1] *Phys. Rev.*, **36**, 1; 1932.

Structure of Line Spectra in Crystals

NEW investigations of the spectra of chromium in crystals[1] have rendered very probable the surmise expressed by Saha[2] as to how these spectra originate. The possibility is thus afforded of enlarging the explanation proposed previously[3] resulting in the main characteristics for a transition of an ing spectra of absorption determined by J. Becquerel, as I gather from a discussion with Mr. Gorter, of Harlem. The temperature behaviour of the lines is as expected (strong dependence on temperature of $^3F-^3H$ in relation to $^1G-^3H$ in praseodymium). Also the appearance of the transitions leading to the deepest level in absorption is fulfilled. As regards the intensities of the single lines, the transitions

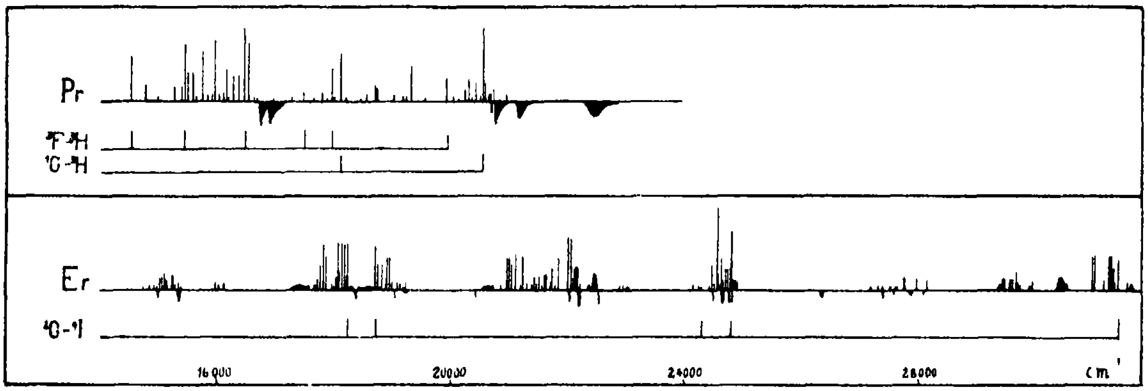

FIG. 1.

electron and its change through the crystal lattice, inasmuch as now also the laws of the various transitions of electrons for the spectra of phosphorescence of the rare earths can be investigated. The explanation of transitions $4f^{z} \rightarrow 4f^{z-1}\,5d$ offered by Laporte[4] should come into consideration only for the diffuse spectra of the rare earths, for example, of neodymium (also of samarium[5]).

In analogy with chromium we might attribute the sharp spectra to transitions without change of the electronic configurations. Then the principal transitions of electrons appearing in the respective spectra must be attributed to the multiplets produced by the combination of the possible terms of the unchanged electronic configurations. The separation of these terms has been calculated according to a method indicated by Goudsmit[6], and the single term intervals have been fixed according to the Landé interval rule. A very good concordance of the values calculated with the strongest lines of the emission spectrum, for example, in CaO, becomes manifest, as shown by Fig. 1 with the example of praseodymium and erbium, the values of which are indicated according to my own investigations and those of Evert and Fagerberg. The remaining lines originate in accordance with the former explanation partly from lattice oscillations and perhaps also molecular oscillations, partly also from Stark effects.

As these lengthy calculations of the splitting of the terms have not yet been carried out for all electron arrangements, the following combinations have been found up to now:

Pr: $^3F-^3H$, $^1G-^3H$, $(^1S-^3P)$
Nd: $^2I-^4I$, $^2G-^4I$
Sm: $^4F-^6H$
Er: $^2G-^4I$, $(^2K-^4I)$

The transitions without change of the spin are situated at longer waves than the corresponding ones with change of the spin. The screening constants are $\sigma_2 = 33 \cdot 0 \pm 0 \cdot 2$ for praseodymium, neodymium, samarium and erbium without appreciable direction of the different values.

The possibility of such transitions corresponds very well to the oscillator strength of the correspond-

$\Delta J = \Delta L$ are, so far as it is possible to judge qualitatively, mostly the strongest, even when $\Delta J = \Delta L = \pm 2$.

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Sept. 26.

[1] O. Deutschbein, Z. Phys., 77, 492; 1932.
[2] NATURE, 125, 163, Feb. 1, 1930.
[3] R. Tomaschek, Z. Elektrochemie, 36, 737; 1930.
[4] Phys. Rev., 35, 30; 1930.
[5] R. Tomaschek, Phys. Z., 1932.
[6] Phys. Rev., 31, 946; 1928.

Anomalous Behaviour of Methane in the Raman Effect

DICKINSON, Dillon and Rasetti,[1] who examined the Raman spectrum of methane, did not report the presence in it of any pure rotational lines accompanying the Rayleigh scattering. To decide whether indeed the rotational scattering is absent in the case of this gas, spectrograms were obtained by giving prolonged exposures up to a week, but without recording even a trace of such scattering by way of either discrete lines or unresolved bands alongside the undisplaced lines of the mercury spectrum. Special devices for eliminating stray light and weakening the Rayleigh scattering with the aid of a nicol were employed in order to secure the most favourable conditions for the observation, but these made no difference to the result stated.

The absence of a rotational scattering, which is thus indicated in the case of methane, is an extremely surprising result, as it is well known that the Rayleigh scattering by the molecules of this gas is depolarised to an appreciable extent[2] (1·14 per cent), and theory indicates a direct connexion between the magnitude of such depolarisation and the intensity of the rotational Raman lines. Moreover, gases such as hydrogen chloride, ammonia, and carbon monoxide which show comparable or even smaller depolarisation values have been observed to exhibit strong rotational scattering.

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Oct. 8.

[1] Phys. Rev., 34, 582; 1929.
[2] Ind. J. Phys., 7, 139; 1932.

Fixation of Mitochondria

THE importance of always omitting lipide solvents from fixatives for mitochondria has, I think, been exaggerated. I find that mitochondria are readily demonstrable in the liver of the newt and the kidney of the mouse even after fixation with Carnoy's alcohol-chloroform-acetic, which should certainly remove all lipides. Bouin's fluid preserves the mitochondria in the liver of the newt as well as the standard mitochondrial fixatives. When in Dalmatia in the summer I put the testes of some Hemiptera (*Syromastes marginatus*) into Bouin's fluid and left them in it until my return to England. On sectioning them I found the filamentous mitochondria of the primary spermatocytes well preserved.

Although mitochondria are in certain cases preserved by these methods, they are not thereby mordanted for subsequent staining. It is best to bring the sections to water and then leave them overnight in three per cent potassium dichromate in a paraffin oven. Next morning they are washed in running water for five minutes, and then stained by Altmann's technique or one of its modifications.

Champy[2] mentioned in 1911 that mitochondria are sometimes preserved by Bouin's fluid, and Romeis[3] in 1913 saw them, somewhat distorted, after Carnoy's fluid without chloroform. It seems that when there is a large protein component in mitochondria, there is no necessity to omit acetic acid and lipide solvents from fixatives used to show them.

I wish to retract my recently published remarks[1] on the fixative action of quinone. I placed tissues in quinone solutions and then transferred them to Carnoy's fluid. Mitochondria were not dissolved. In view of the current opinion regarding the action of Carnoy's fluid on mitochondria, I concluded that quinone was a powerful fixative for them. It is now clear that the evidence for this conclusion was insufficient.

JOHN R. BAKER.
University Museum, Oxford.
Oct. 8.

[1] Baker, J. R., NATURE, **130**, 134, July 23, 1932.
[2] Champy, C., *Arch. d'Anat. micr.*, **13**, p. 55; 1911.
[3] Romeis, B., *Arch. mikr. Anat.*, **81**, p. 129; 1913.

Factors Determining the Distribution of *Apion ulicis*

IN connexion with the noxious weed control investigations at Farnham Royal Laboratory on behalf of the New Zealand Government, an experiment has been carried out in order to throw light upon the nature of the factors limiting the distribution of *Apion ulicis*; for this weevil is not found throughout the areas occupied by its host plant, *Ulex europæus*. Its abundance on the Moray coast, for example, and its absence from the Aberdeen district suggest the possibility that climatic factors in the north may only be suitable in the warmer districts.

The experiment consisted of the introduction of 25,500 mature insects, beaten off bushes, to an island in the River Don near its mouth at Bridge of Don, Aberdeen. This island is several acres in extent and has many large clumps of gorse upon it. Careful search was made previously to ascertain that no *Apion ulicis* was there. In November 1929, 500 Apions, collected from Nairn, were liberated; in January 1930, 5,000 from Buckinghamshire were liberated, and in April 1930 Dr. Guy Morrison liberated 20,000 from Buckinghamshire after making another search on the island for *Apion* and finding none. The gorse was in full bloom at the time of this last liberation. In April 1931 half an hour's beating of the bushes resulted in the finding of 15 live specimens of *Apion*, so that a considerable number must have survived the winter. In August 1932 another search was made and although only one dead *Apion* was beaten off the bushes, there were well developed *Apion* larvæ in four pods out of 300 examined, the total number of pods present being probably 1–200,000. Thus there is evidence that both winters must have been survived by many of the weevils and that normal breeding had taken place this year and probably last year also.

It may be, then, that the limited distribution of *Apion ulicis* is attributable to inadequate dispersal, but observations over a longer period are necessary before it can be definitely attributed to this cause rather than to the occurrence of occasional devastating conditions, such as long-continued low temperatures during the breeding season.

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Undeciphered Scripts

REFERRING to the note in NATURE of October 1, p. 502, on the similarity of ancient scripts found in the Indus Valley and in Easter Island, it may be mentioned that Prof. Herman Wirth, of Marburg, has also directed attention to a number of similar symbols that have been found in North and South America, Sweden, Southern Andalusia, Mesopotamia, Africa and Oceania. He explains some of these signs on the usual lines of literal interpretation; but the fact that so many ideographs, "even [!] the *Svastica*" as Sir Denison Ross observes, are found in diverse parts of the world suggests that a certain class of archaic symbol cannot be interpreted as mere pictographs of material objects and local events. They obviously constitute the elements of a universal 'language' the symbols of which represent functions of Nature. The practical scientific knowledge of prehistoric civilisations implies some familiarity with the operations of the dual, positive and negative principle in Nature.

The knowledge of the physicist and biologist, hitherto neglected in palæographical research, may be required for the interpretation of some of these undeciphered 'scripts'. The geometrical and algebraical 'functions' of stresses, strains, and transformations of 'lines of force', do not vary from age to age; and, although the symbols for these in one era may seem abitrary to the savants of another age, the man of science is much more likely to find the 'key' than the man of letters.

W. W. L.

Photochemical Synthesis of Vitamin B_1

[BY CABLE]

ADENINE SULPHATE has been activated into vitamin B_1 by irradiation with ultra-violet light. Guanine chloride could not be activated similarly. Tests were carried out on rats according to the technique previously described. Details will appear elsewhere.

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Bengal Chemical and Pharmaceutical Works, Ltd.,
Calcutta, Nov. 7.

Research Items

Stone Circles in Tongareva.—In an account of the ethnology of Tongareva, commonly known as Penrhyn Island (Bull. 92, Bernice P. Bishop Museum, Honolulu), by Te Rangi Hiroa (Dr. P. H. Buck), reference is made to two roughly circular arrangements of limestone pillars. Nothing is known of their uses and no name is applied to them by the islanders. It has been stated that stone circles of a Stonehenge type are present in Tongareva—an erroneous interpretation of the word 'encircled' used by Lamont loosely in describing a marae which in reality was rectangular. The stones are not to be ascribed to an archaic civilisation; they are of the same type as those used in marae construction, and sun worship was unknown to the Tongarevans. The pillars, including the bilateral notched pillar of the Atutahi ellipse, are trimmed in the same way as the marae pillars. They must have been made by the ancestors of the present population. They are in fact extra-marae pillars set up near the marae for some subsidiary purpose which, it is suggested, were social gathering places on the way to or from the marae. Women and children were not allowed to enter the marae. The secular use of the circle may be borne out by the discovery of a partly worked shell fish-hook in one enclosure. The circle may have been used as the place in which was performed the dance and the wailing ceremony, an accessory performance outside the marae that required a clear space not far away. The circle probably arose from a desire to embellish the clear space where such dances were held. In function it would be subsidiary and complementary to the marae and not taboo.

Cherokee Medicine.—The late James Mooney left unfinished a study of a manuscript of Cherokee sacred formulæ and medicinal prescriptions, which has been completed, edited and checked in the field by Dr. Franz M. Olbrechts and is published as Bulletin 99 of the Bureau of American Ethnology. The Cherokee original has disappeared. While the Cherokee recognise that natural causes, much as the fall of a branch of a tree, may bring about an injury, they may still explain it as due to the machinations of an enemy, while disease in general is attributed to the action of spirits, anthropomorphic or zoomorphic, out of revenge fo. a slight. A rival spirit will then be called in to drive the attacking spirit away. Spirits cause disease not only of their own volition, but also by being invoked by witches or a man-killer. Such spirits are the sun, the moon, the river, which is the central object of an important cult, thunder (more of a disease expeller than a cause of disease), the two sons of thunder, known as the two Little Red Men, the Purple Man, the Blue Man, the Black Man, etc., and the Little People, who act in groups rather than individually. The animal spirits are prototypes of the common animals, but exceed them in their qualities. To these must be added human and animal ghosts. Dreams may also cause definite ailments. Cherokee medical art does not aim at curing disease or allaying pain, but at removing the cause, which it is the first duty of the medicine man to ascertain, in the first place by interrogating the patient as to whether he has infringed any taboos or has had any dreams. Great as is the number of spirits causing disease, the number of those who drive it away is even greater. If a disease is thought to be caused by worms, worm-eating bird spirits will be called in. If the disease is of a very tenacious nature, the spirits of rats, beavers or weasels will be called in, because they also are tenacious and will gnaw and tear the disease-causing spirits.

Californian Shrimp Industry.—In the Fish Bulletin No. 38 of the Division of Fish and Game of California, Bureau of Commercial Fisheries, 1932, Mr. Paul Bonnot deals with the Californian shrimp industry in San Francisco Bay, both historically and statistically. Three shrimps make up the commercial catch, all species of *Crago*: *C. franciscorum*, *C. nigricauda* and *C. nigromaculata* in order of their abundance. These are all large animals measuring 2½–3 in. in length. Their life history is little known. Eggs may be found attached to the females throughout the year at various stages of development but there are no records of young shrimps being taken in the catches. Presumably they pass through the nets. Besides shrimps, *Pandalus danæ*, *Spirontocaris cristata* and *Upogebia pugettensis* are occasionally taken and large numbers of *Euphausia pacifica*, with numerous fishes of many varieties. The Chinese shrimp net and the shrimp trawl are both used and appear to be equally efficacious as the amounts of the catches from each differ little. The shrimps are for the most part boiled and put into barrels to be sent away to the dried shrimp market in China. The catches have greatly increased in the last fifteen years, rising from 200,000 lb. in 1915 to 3,000,000 lb. in 1929. The largest numbers were in July to October. Sun-dried shrimps lose three-fifths of their weight in the process. The dried material yields one-third shrimp meats and two-thirds shrimp meal by weight.

The Peritoneal Melanophores of Fishes.—The dermal chromatophores of fishes have been much studied but relatively little is known of the internal chromatophores present in the peritoneum, the pericardium, the walls of the larger blood vessels, the membranous coats of the central nervous system and elsewhere. In common cyprinoid fishes two kinds of peritoneal chromatophores are present, namely, melanophores and guanophores (or iridocytes) but there are no xanthophores. In the small Japanese species of minnow, *Acheilognathus intermedia*, selected for study by K. Yamamoto (*Mem. Coll. Sci.*, Kyoto Imp. Univ., Ser. B, vol. 7, No. 4, Art. 9, 1931) internal melanophores are plentiful; each is a minute stellate cell with numerous peripheral processes rich in dark brown or black pigment. It differs in shape from the dermal melanophore, for the latter has longer peripheral processes, and in distribution, for the peritoneal melanophores are more densely crowded so that they more readily join to form a continuous black screen. A single large peritoneal melanophore is surrounded by ten to thirty smaller ones all of which react together in expansion or in contraction. The dermal melanophore expands when the fish is kept in the dark and contracts when the fish is kept in the light; the peritoneal melanophore reacts in the opposite manner. Damage to the brain does not change the reaction of the peritoneal melanophore. In general the reaction time of this melanophore is slower than that of the dermal.

Hybrids of the Grass *Phalaris*.—Crosses have been made between *Phalaris arundinacea*, a grass of wide distribution in the northern hemisphere, and *Ph. tuberosa*, a Mediterranean species (T. J. Jenkin and B. L. Sethi, *J. Genetics*, vol. 26, No. 1). More seeds and a higher percentage of germination are obtained when *Ph. arundinacea* is the female parent. Both species are found to have $2n=28$ chromosomes, and hence are tetraploid, but in the hybrid meiosis 12 pairs of chromosomes are formed and 4 univalents. In both parent species there are 14 pairs of chromosomes in meiosis, but one or two bivalents may lag on the heterotypic spindle. The hybrids are functionally male-sterile, but a few good pollen grains are probably produced. They are vigorous and set seed freely in proximity to the parent species. Later generations showed considerable variability. On the basis of these results the theory of the hybrid origin of the Australian Toowoomba canary grass, which is also variable, is revived. It is suggested that this form, the status of which has been disputed, resulted from natural crosses in Australia between the introduced species, followed by back-crossing to *Ph. tuberosa*. It cannot be proved, however, that *Ph. arundinacea* was growing in Toowoomba at the time these crosses are supposed to have arisen.

Kimberlite in Tanganyika Territory.—The Shinyanga diamond fields have already been described by Dr. E. O. Teale in Short Paper No. 9 of the Geological Survey of Tanganyika Territory. Kimberlite occurrences have more recently been discovered on the Iramba Plateau, south-east of the former area, and these are now described in Short Paper No. 10, also by Dr. Teale. At Kisiriri the kimberlite occurs in sheet-like intrusions penetrating the granite along flat-lying joint planes; most of the sheets have chilled margins, the thickness ranging from thirty feet down to mere threads. At Kiomboi an irregular elliptical pipe occurs and other occurrences of kimberlite that probably lie over pipes are known in the Songeli and Mtawira districts. In some of these areas pitting and washing have been carried out, both on superficial gravels and on weathered kimberlite, but so far without encouragement except in the Songeli region, where two diamonds are reported from the river gravels. All the typical minerals such as ilmenite, garnet, olivine, diopside and zircon are found, and the Kiomboi pipe contains eclogite and numerous blocks of sandstone like that of the Upper Karroo. No outcrop of the latter is now present in the vicinity and the inclusions must have fallen in from a former capping of the formation.

Room Comfort.—It is now nearly twenty years since Sir Leonard Hill introduced the cooling of a thermometer bulb at body temperature as an indicator of the comfort of a room. The smallness of the instrument has been found disadvantageous and a committee of the Medical Research Council and of the Department of Scientific and Industrial Research has adopted a comfort-measuring device which was described briefly by Mr. A. F. Dufton of the Building Research Station in the *Philosophical Magazine* for May 1930 and is now described in detail by him in Technical Paper No. 13 of the Building Research Board entitled, "The Equivalent Temperature of a Room and its Measurement". It consists of a cylindrical vessel of thin copper painted black, 56 cm. high and 19 cm. in diameter, the temperature of which is maintained at 75° F. by a bi-metallic thermostat and a relay mercury switch which control the electric current through two electric lamps in the vessel, on a 200-volt circuit. A portion of the current flows through a coil which heats a thermometer, or a thermo-junction if a continuous galvanometer record is required. The indications of the instrument are thus proportional to the excess of 75° F. above a temperature for which the term 'equivalent temperature of the room' is proposed. The device is to be called a 'eupatheoscope'.

Polarity of Thunderclouds.—Experiments have been made in South Africa (E. C. Halliday, *Proc. Roy. Soc.*, October) to investigate the structure of thunderclouds by studying the changes in the atmospheric potential gradient accompanying different types of flash. The capillary electrometer invented by C. T. R. Wilson for such work was used, and an observer wrote notes on the flashes, at the same time marking the electrometer record. In some cases photographs of the flashes were taken. In 283 cloud-to-ground flashes, nearly all were accompanied by positive charges of the electric field. When the flashes took place within clouds, they usually produced negative field charges when distant and positive field charges when near. These results are consistent with Wilson's view that thunderclouds are charged positively above and negatively below. A number of simultaneous earth-cloud and within-cloud flashes were also observed.

Experiments with High-Speed Protons.—Chr. Gerthsen describes in *Die Naturwissenschaften* for September 30 an ingenious method for multiplying the energy of hydrogen positive ions. The ions are accelerated *in vacuo* and passed through a chamber filled with hydrogen where a process of exchange of charge takes place and fast neutral hydrogen atoms are produced. The neutral particles pass through a region of reversed potential into a second exchange chamber where fast positive ions are produced and these are accelerated by a potential derived from the same source as before. The arrangement tried gave proton currents of 10^{-8} amp. at velocities corresponding to 2×70 kilovolts, and the experiments of Cockcroft and Walton on lithium disintegration were repeated. The repeated application of the process is hindered only by intensity considerations, particularly as the probability of exchange of charge decreases with increasing particle velocity.

Sub-boundary Structures in Metals.—Deeply etched iron not infrequently shows within the crystals of ferrite a network the nature of which has been very obscure. Hitherto the general explanation has been that such sub-boundary structures were evidence of minute crystals the orientations of which varied very slightly. Similar effects have been noted in cast nickel and copper. In a paper to the Iron and Steel Institute (September, 1932), L. Northcott advances the view, which is supported by considerable experimental evidence, that oxygen in the metal is the cause. Iron which had not previously shown this structure did so when heated in contact with iron oxide, while a veined structure was removed by annealing in hydrogen within a certain range of temperature. The two other metals mentioned gave similar results.

Atomic Weights of Selenium and Tellurium.—The values obtained by Aston by the mass-spectrum method in the case of selenium and tellurium differ appreciably from those adopted in the International Tables of Atomic Weights. A revision of the chemical determinations has been carried out by Hönigschmid, who reports in *Die Naturwissenschaften* (1932, p. 659) that the analysis of silver selenide gives Se = 78·962 ± 0·002, coinciding with Aston's result, whilst the analysis of $TeBr_4$ gives Te = 127·587 ± 0·019, differing by 0·4 from Aston's value but agreeing with the International value and with a combination of Aston's results with the more recent mass-spectrum experiments of Bainbridge (*Phys. Rev.*, 1021, 1932), which disclosed some new lighter isotopes. A combination of the two spectra gave Te = 127·58 ± 0·15, in correspondence with the chemical value.

Mechanism of Flame Movement.—In the *Journal of the Chemical Society* for July, 1932, Coward and Hartwell, of the Safety in Mines Research Laboratories, describe experiments on the uniform movement of flame in mixtures of methane and air, with particular reference to the effect of the diameter of the tube on the rate of propagation. They confirm the fact that the speed of flame increases with increase in tube diameter; in a tube of 100 cm. diameter, a 10 per cent methane – air mixture would be propagated at about 250 cm./sec., whereas in one of 2·5 cm. diameter at only about 65 cm./sec. For tubes between 10 cm. and 20 cm. in diameter, there appears to be an inflection in the curves representing the speed. The authors explain this by reference to the nodular appearance of the flame, which is due to convection in the flame front, and does not occur in tubes of small diameter. The enlargement of the flame surface increases the mass of the gas burnt in unit time, and the speed of flame increases accordingly. Even in the case of downward propagation of flame in wide tubes, these irregularities in the flame front are visible, and the authors plead that 'uniform movement' of flame may be regarded as an early phase of sensibly uniform speed usually observed in the propagation of flame (through a quiescent gaseous mixture) from the open end of a straight tube towards the closed end, but not as resulting from a particular mode of heat transference, representing the normal speed of propagation of flame by conduction of heat.

Astronomical Topics

The Leonid Meteors.—A Science Service Bulletin, by James Stokley, points out that even people who have no astronomical training can do useful work in observing the Leonid meteors. It will help to determine the time of maximum if they count the numbers seen during each hour of the night. If the meteors are too numerous for all to be counted, the count may be limited to a definite region of the sky, bounded by known stars, which should be noted in making a report; a region should be chosen that will remain in sight throughout the watch. An alternative study is that of the brightness of the meteors. The planets Jupiter and Mars, and the star Regulus will be suitable for comparison. Each observer should limit himself to some definite field of work. The most probable nights are those between November 15 and 16, and between November 16 and 17. The moon will prevent observation of faint meteors, but there should be many bright enough to be seen.

The observatories of Kodaikanal and Helwan have been asked to telegraph to the B.B.C. if they see a rich shower, so there is a possibility of receiving warning before the radiant point rises (a little before 11 P.M.). As the rich portion of the shower takes about four hours to be crossed by the earth, it is more or less an even chance that some portion of the rich shower may occur in the interval between 11 P.M. and sunrise. In 1866 the nodes of Tempel's comet and the meteors were practically identical (231° 26′ comet, 231° 28′ meteors). The calculations of the B.A.A. Computing Section give 233° 54′ for the comet's node this year; if we assume the same for the meteors, the maximum would be about noon on November 16. The most hopeful time appears to be just before dawn on November 16. The sun rises at 7^h 19^m in London.

A Perplexing Variable Star.—The variability of the star R Scuti was discovered by Piggott in 1795, but the law of its variation defied analysis for more than a century. A special study of the star during the period 1911–1931 has been carried on at the Observatory of the University of Michigan, first under Dr. R. H. Curtiss, and after his death by Mr. D. B. McLaughlin. The results are contained in *Publications* of the Observatory, vol. 9, Nos. 9 and 10. It may be described roughly as of the β Lyrae type, with two unequal minima, the average length of the double cycle being 143 days; on the average the B minima occur 62 days later than the A minima. The brightness at maximum is fairly constant at mag. 5 or slightly fainter; that at minimum is very irregular. Sometimes it does not fall below mag. 6, while early in 1925 it fell below mag. 8. The most curious feature is that sometimes the A minimum, sometimes the B minimum, is the deepest; there is a suggestion that these disturbances of sequence occur at intervals of nine cycles, or about 1300 days. The 143-day period is also subject to cyclic variations. The paper does not attempt to give any physical explanation of the star's curious behaviour.

Total Solar Eclipse Observations.—It was mentioned as a 'novel resource' in a paragraph in the columns of "Astronomical Topics" in NATURE of October 1 on the total solar eclipse of August 31, that some parties of observers had dashed by motor cars to places where the clouds were less dense. Dr. Elihu Thomson, director of the Thomson Research Laboratory, General Electric Company, Lynn, Mass., writes: "In observing the eclipse of June 6, 1918, in Colorado, U.S.A., I secured an automobile for the very purpose of following the blue sky, and after making two shifts, reached a high ridge under blue sky just three minutes before totality and had an excellent view in consequence. I believe this process was novel at the time and was referred to in the Harvard Observatory Annals. In the last eclipse, I, with friends accompanying me, repeated the same process and saw the total phase of the August 31st eclipse, which would otherwise have been missed."

The Origin of Igneous Rocks

A DISCUSSION on the origin of igneous rocks was held in Section C (Geology) of the British Association at York on September 7. The discussion was opened by Prof. Arthur Holmes, who sketched out a general scheme of petrogenesis in the light of our present knowledge concerning the geological history, structure and thermal condition of the earth's crust. In certain continental regions the sedimentary and granitic layers appear to be separated from a deeper 'basaltic' layer by one which is probably composed of both acid and basic materials. The 'basaltic' layer is itself composite, a tentative interpretation being that amphibolite (a potential source of oversaturated basalts) is succeeded in depth by more basic granulite (a potential source of undersaturated basalts). Beneath these layers peridotite probably comes into place, merging within a few tens of kilometres into the glassy state regarded as characteristic of the substratum. Given some such setting of materials, igneous activity could arise, either by the ascent into the crust of heat from the feebly radioactive substratum, or by the accumulation of heat in specially thickened belts of the more strongly radioactive crustal rocks. The latter process fails, however, to account for the flooding by plateau basalts of regions where the crust has been thinned by denudation, and also for the ascent of granitic magma *during* orogenesis instead of long afterwards. The hypothesis of refusion of the crustal layers by heat from the substratum, with successive production of peridotitic, basaltic and granitic magmas, therefore seems to be worthy of special consideration.

From the fact that the basaltic magmas of the Inner Pacific differentiate towards trachyte and fail to produce rhyolites and dacites, it is possible to infer that the latter could be developed in quantity only where pre-existing granitic material has been available for refusion. To test the validity of this inference, which is supported by many other lines of circumstantial evidence, Prof. Holmes suggested a method based on the generation of Ca^{41} from K^{41} and its accumulation during geological time. If a Tertiary granophyre or other acid rock had been produced by refusion of pre-existing granite, then its Ca^{41}/Ca ratio should be of the same order as that for, say, Lewisian granite-gneiss. If, on the other hand, the granophyre had been a differentiate from basaltic magma, the Ca^{41}/Ca ratio should be of the much lower order characteristic of basalt. Determinations of Ca^{41} by Dr. F. Allison, who has devised an extraordinarily sensitive magneto-optic method of isotope detection, are now in progress with the view of trying out the practicability of the proposed test.

Attention was directed to the results of much recent work supporting the view that in both kratogenic and orogenic regions many 'intermediate' rocks have been generated as a result, not of differentiation acting alone, but of differentiation superimposed upon (*a*) the hybridisation of granitic magma by relatively basic igneous, metamorphic and sedimentary rocks, or (*b*) the acidification of basic magma by sialic materials. Turning to the consideration of ultrabasic rocks, Prof. Holmes suggested that in addition to peridotites representing accumulations of early-formed crystals from basaltic magmas there are others that have been intruded as peridotite magmas. It was maintained that the conditions favourable to the refusion of crystal-accumulates from basaltic magma would also suffice to generate magma from the peridotite layer at the base of the crust. The genesis of felspar-free alkali-rocks can be plausibly explained by assuming a peridotitic parentage for these rocks. It is not denied, however, that in some of its local applications the 'limestone assimilation' hypothesis has many attractive features.

From each of the different types of parental magmas—acid, basic and ultrabasic—a wide variety of rock-types can be produced by additive and subtractive differentiation, by assimilation, by the mixing of, and reaction between, various products (lamprophyres ?) and by all these processes acting concomitantly. Further possibilities of variation are introduced by differential fusion, and Prof. Holmes pointed out that magmas generated under stress are likely to be of abnormal composition (spilitic ?) as compared with those due to passive refusion.

Prof. A. Brammall examined evidence for the syntectic origin (as opposed to 'pure-blooded' descent from primary basic magma) of saturated and oversaturated magmas, with special reference to quartz-monzonites, hornblende-biotite-syenites, diorites, granodiorites and granites. He endeavoured to liberate the general genetic problem from what he aptly termed "the tyranny of the silica percentage". By eliminating normative quartz from analytical data for igneous, metamorphic and sedimentary rocks and plotting the results in triangular diagrams, he focused attention on progressive variation in the ratios of (*a*) salic to femic constituents, and (*b*) Ab to Or + Cor, in a theoretical differentiation suite. From this standard trend of variation the rock-types mentioned appear to be markedly aberrant. Not only does such aberration, in itself, logically hint at contamination, but also the rock-types displaying it are those for which a syntectic origin has been frequently asserted on first principles and convincingly demonstrated by field and geochemical evidence. Moreover, the crustal rocks actually assimilated in particular cases are of the general composition predicable from the 'overlap' of composition-fields plotted. Both the basification of acid magma, and the converse process, may be regarded as comparatively simple cases of the kind to be expected. The analytical and graphic methods outlined may afford some lead in the difficult problem of assessing probabilities concerning the fact of assimilation, and the composition of material which may have been assimilated at inaccessible depths before the consolidation of coarse-grained and essentially homogeneous rocks.

Prof. Brammall urged the need for intensive geochemical work on country-rocks—directed, in particular, to the study of 'consanguinity' as a further and possibly decisive criterion. Citations included progress reports on (i) the basic sills intrusive into Cambrian Shales flanking the Malverns near Eastnor, by Mr. F. G. H. Blyth, and (ii) hornblende-gabbro intrusive into Malvernian Schists at Hollybush, by Miss A. E. Cook and Prof. A. Brammall.

Dr. G. W. Tyrrell discussed the nature, mode of occurrence, and origin of basaltic magmas. He regards the existence of two main types of basaltic magma as established: the oversaturated or tholeiitic, and the undersaturated or crinanitic. In relation to geological environment three groups can

be distinguished: (*a*) *flood-basalts* (mainly over-saturated); (*b*) *oceanic basalts* (largely undersaturated); (*c*) *cone-basalts*, including those of rift valleys, horsts and troughs (dominantly undersaturated and notably felspathoidal). It was pointed out that the oversaturated type of magma has appeared at infrequent intervals but in enormous volumes, and that its chemical composition, as represented by basalts and quartz-dolerites, has been remarkably constant in space and time. While deriving undersaturated magmas directly from the basaltic layer, Dr. Tyrrell suggested that the oversaturated type may have originated by selective fusion of the peridotite or 'stony-meteorite' zone underlying the basaltic layer.

Dr. A. K. Wells expanded the evidence favouring refusion of ultrabasic material, with special reference to the dunite pipes of the Bushveld Complex. He endorsed the opinion that these 'carrot-shaped' intrusions are magmatic infillings, but regards them as re-fused differentiation products from the noritic magma of the Complex. Slides were shown demonstrating that both chromitite and magnetite-rock (presumed to have been derived from the norite) have behaved as fluids towards the associated silicate rocks. This striking reversal of the usual relations makes it not unreasonable to postulate refusion of early segregations. In connexion with the origin of the alkali rocks, Dr. Wells regrets that most British petrologists seem loth to accept the 'limestone-assimilation' hypothesis. He thinks the chain of circumstantial evidence cited by Prof. Shand is sufficiently strong to carry conviction, and he deprecates any suggestion that ijolite cannot be derived from basaltic or granitic magma, on the ground that it unfairly rules out the 'limestone-assimilation' hypothesis altogether.

Prof. H. H. Read examined the quality of the field-evidence connected with petrogenic theories. The rapid changes in the fashionable theories are clearly due to imperfections of field-knowledge. Arguments based upon badly exposed igneous bodies, such as the alkaline mass of Loch Borolan and Cnoc na Sroine in Sutherland, are obviously of little value. If petrologists endeavoured to assess the quality of their field-evidence we should have a guide to the order of validity of their conclusions. In Prof. Read's opinion, the field-evidence for refusion and palingenesis is entirely inadequate. In the case of contamination and hybridisation, however, the presence of discontinuities, and the complex and variable nature of the products, make the field-evidence of great value; but even here, the application of knowledge gained in these obviously mixed rocks to the interpretation of rocks about which no such field-evidence is forthcoming should be made with caution. The most important testimony in favour of assimilation as a petrogenic process is that read from field-evidence.

Mr. S. I. Tomkeieff presented an interim report of an investigation carried out in collaboration with Mr. C. E. Marshall on the Tertiary dykes of north-east Ireland, with special reference to 130 dykes of the Mourne swarm. These included olivinic types, but a majority belonged to the oversaturated and 'intermediate' types (andesitic variolites, leidleites, innimorites, etc.). The 'intermediate' types invariably contain half-digested xenocrysts of felspar and quartz, while xenoliths of partially fused granitic rocks are generally abundant. The field and petrographic evidence was found to be in perfect agreement with the views expressed by Prof. Holmes as to the origin of the similar suite of andesitic tholeiites occurring in the north of England. Mr. Tomkeieff outlined the igneous history of the Mourne centre as a whole and showed that the details are those to be expected on the theory of successive refusion advocated by Prof. Holmes.

Mr. W. Campbell Smith, in commenting on the views expressed by the previous speakers, pointed out that, from the nature of the case, field evidence of palingenesis was not to be expected on anything more than a very limited scale. He is disposed to counsel caution in extending the explanation offered for the evolution of leucitic rocks to the still less tractable problems of the soda-rich rocks.

Dr. H. Jeffreys said that the origin of the crustal layers themselves had not been touched upon, though he contends that this is the fundamental problem. He considers that the granitic and basaltic layers probably represent the products of residual magmas left over from the crystallisation of the material of the Lower Layer, and suggested the possibility that the process may still be going on.

International Institute for Documentation

THE eleventh Conference of the International Institute for Documentation was held in the Bibliothek für Kunst und Technik, Frankfurt am Main, during the week which ended on September 3. Great credit is due to Dr. Walter Schürmeyer, Director of the Bibliothek, for the excellent manner in which the Conference was planned and carried out. It is of interest to note that this Conference was the first held under the Institute's new title of "Documentation", which at the Tenth Conference (of the "Institut International de Bibliographie", as it was then called), held at the Hague on August 24–29, 1931, was chosen as a more appropriate title, in view of modern developments in the collection and classification of the records of intellectual activities.

On the first day, members of the Conference were received by the mayor and municipal authorities of Frankfurt, and by the Rector of the University, in the historical Kaisersaal des Römers; after which, a public assembly was held in the town hall, when Dr. J. A. Prins, director of the Dutch Patent Office, delivered his presidential address. All papers presented at the Conference were issued in two bound volumes[1] to participants in advance. M. Paul Otlet, one of the founders of the Institute in Brussels, spoke on the history and fundamental principles of documentation, and Dr. Ehrenfried Pfeiffer[2] described the technical documentation service of the Verein deutscher Ingenieure in Berlin.

There was a short discussion of the joint paper, "Systematic Subject Indexes to Periodical Volumes" by Prof. A. F. C. Pollard and Dr. S. C. Bradford[3], in which is described the method of the subject-matter index to volume I (1931) of the *Power and Fuel Bulletin*,[4] a notable development of indexing practice.

In Great Britain, where an undecimalised and therefore troublesome system of measures and money is still patiently endured, one would least expect to find the decimal system extensively adopted in the classification of literature; but Dr. S. C. Bradford[5] quotes a list of 28 important British scientific

institutions which, even in the year 1930, had decimalised and thus simplified their documentation. The fundamental value of decimal classification lies in its mechanical simplicity, its universal application, and its 'pure' numerical symbolisation which overrides all language barriers and opens up wonderful possibilities of international co-operation. The enthusiasm of all who have adopted the system and proved its worth, shows it to be a vital factor in modern librarianship.[6]

Abbreviated editions of the "Classification Décimale Universelle, Table systématique complète" have appeared in German[7] and in Spanish,[8] and a Danish edition is now in preparation. All such editions will be faithful translations of the French, and will follow the German in respect of abbreviation. The "Index Alphabetique de la Classification Décimale", a comprehensive alphabetical subject-matter index to the whole of the decimal classification system, can now be obtained from the Institut International de Documentation, Palais Mondial, Bruxelles.

In the course of the Conference, an exhibition was set out in the Bibliothek für Kunst und Technik, to illustrate modern library equipment, such as visible file indexes, photostat apparatus, and the application of the 'Adrema' system in mechanical selective documentation, which has been adopted with considerable success in the Bibliothek der Technischen Hochschule, Berlin,[9] for example. The Adrema Co. has now worked out in detail a scheme for the direct mechanical selection of decimal references to six places (that is, up to 999,999 or a million classification sub-divisions[10]).

At the conclusion of the Conference, a dinner was held in the clubhouse of the Frankfurter Gesellschaft für Handel, Industrie und Wissenschaft, a feature of which was the decimalised menu card. This was the work of Dr. Julius Hanauer, who threatened that at the next Conference he would produce an international menu card of decimal numbers without words. It was provisionally decided that the next Conference of the Institute should be held in Paris next summer, in collaboration with the Institut International de Co-opération Intellectuelle.

H. P. SPRATT.

[1] "I.I.D., Vorträge der 11. Konferenz" Bibliothek für Kunst und Technik, Frankfurt am Main. 6 gold marks the two volumes.

[2] "Der Literaturnachweis des Vereines deutscher Ingenieure". I.I.D., Vorträge der 11. Konferenz, vol. 2, p. 243.

[3] "I.I.D., Vorträge der 11. Konferenz", vol. 2, p. 121.

[4] Published monthly by the British National Committee, World Power Conference.

[5] Bradford, Dr. S. C.: "Die Entwicklung der wissenschaftlichen Bibliographie und des bibliographischen Quellennachweisdienstes in England". Minerva-Zeitschrift, Jahr. 7 (1931), Heft 1-2, p. 10.

[6] Spratt, H. P.: "Scientific (Technical) Libraries". Chapt. iii, The Year's Work in Librarianship, vol. 4 (1931).

[7] "Dezimal-Klassifikation, Deutsche Kurzausgabe", bearbeitet im Auftrage des Deutschen Normenausschusses von Dipl.-Ing. Heinrich Günther. Beuth-Verlag G.m.b.H. Berlin, 1932.

[8] "La Clasificación Bibliográfica Decimal", por Luis Mèndez Albarrán. Badajoz, Antonio Arqueros.

[9] Predeek, Dr. A.: "Die Adrema-Maschine als Organisationsmittel im Bibliotheksbetriebe." 20 pp. Berlin, "Organisation" Verlagsges. m.b.H. (S. Hirzel), 1930. 1 gold mark. See also: "Die mechanishe Herstellung und Auswertung des technischwissenschaftlichen Literatur-Nachweises." 's-Gravenhage, Nederlandsch Instituut voor Documentatie en Registratuur, 1930, *Publicatie No. 51*, p. 31.

[10] Predeek, Dr. A.: "An Ever-ready Printed Catalogue." Report of Proc. 8th Conference (1931), p. 47, A.S.L.I.B., London.

Structure of Solid Bodies

AN important symposium on the elementary structure of solid bodies (chiefly non-metallic), at which many distinguished foreign savants participated, was held in Leningrad on September 13–18 at the physico-technical institute.

In an introductory paper, A. F. Joffe (Leningrad) discussed the permanent distortion of crystals and pointed out that structurally perfect crystals offer least resistance to distortion. W. L. Bragg (Manchester) described the results of X-ray analyses of substances of more complicated structure, such as silicates. V. Heitler (Göttingen-Moscow) dealt with a semi-classical theory of the homopolar valence forces. Mrs. M. Classen (Leningrad) described the measurement of the limit of elasticity in perfect crystals and indicated that non-metallic crystals show annealing effects similar to those of metals. J. Frenkel (Leningrad) analysed the concepts 'solid' and 'liquid', pointing out that many properties which used to be considered characteristic of solids are shared to some extent by liquids, and vice versa. Liquids, for example, have a measurable rigidity under high-frequency mechanical oscillations. B. K. Fredericks (Leningrad) discussed the 'swarm theory' of liquid crystals. J. D. Bernal (Cambridge) considered the rational classification of crystals according to the nature of the weakest bonds and the rotation of molecules or radicals present.

J. Errera (Brussels) spoke on the dielectric polarisation of solids, distinguishing between ionic polarisation due to high frequency in substances far from their melting point (sodium chloride), and dipole polarisation due to low frequencies in substances near their melting point (water). A. V. Kurtchatov (Leningrad) dealt with the dielectric properties of Rochelle salt and explained the occurrence of the upper Curie point by the Lorentz interaction of rotating dipoles. The nature of the lower Curie point remains obscure, some ascribing it to the 'freezing' of the dipoles and others to a depolarising action determined by the symmetry of the crystal. N. Achulov (Moscow) considered magneto-striction and explained the abnormal character of the mechanical properties of ferro-magnetic bodies in terms of electronic orientations under the influence of mechanical stresses. He gave, further, a new method for calculating the magnetic susceptibility in crystals. P. L. Kapitza (Cambridge) spoke on magneto-striction in non-ferromagnetic bodies (bismuth and others).

R. H. Fowler (Cambridge) presented a report on Wilson's theory of semi-conductors which attributes their electrical properties to the thermal excitation of a very few electrons into states of motion which enable them to move freely through the crystal. In contrast to metals, the electrical properties of semi-conductors are classical. E. Tamm (Moscow) read a paper on the peculiar 'surface-bound' electronic states in non-metallic crystals and another paper on the calculation of the work-function for metals; in this he showed that the work depends solely on the polarisation of the metal (though the notion of the corresponding 'image-force' is not valid). Finally, J. E. Mayer (Baltimore-Göttingen) dealt with new developments of Born's theory of ionic forces in crystals, based upon the wave-mechanical conception of interatomic forces, and on electrical polarisation.

In connexion with the above symposium, a discussion was held on Dirac's electrodynamic theory to which Fock (Leningrad), Podolsky (Pasadena-Kharkov) and Shubin (Sverdlovsk) made interesting contributions. Nuclear phenomena, especially the

analysis of atomic structure in terms of protons and neutrons, and the repercussion of those phenomena upon the law of conservation of energy, also came in for a fair amount of discussion. Fowler and Dirac (Cambridge), Tamm, Frenkel and others joined in this discussion; its general tone differed from that of the similar discussion which took place at the recent York meeting of the British Association in that the unexplained behaviour of the energy distribution in the β-ray emission of radioactive bodies did not appear to shake the confidence of the speakers in the utility of the postulate of the conservation of energy when applied to subatomic phenomena.

VICTOR COFMAN.

Iron-cored Coils for Radio Frequencies

FOR several years past iron-cored coils for oscillatory circuits have been used by telephone engineers at audio frequencies and at the low radio frequencies which are used in carrier current telephony. In order to reduce the losses which would accompany the use of iron at frequencies of the order of 50,000 cycles per second, the magnetic material was made up in the form of iron dust or filings embedded in a wax or cement in such a way that each particle of iron was insulated from its neighbours. In this way the eddy currents were very restricted in their paths, and the resulting iron losses were reduced to a minimum, so that the presence of the iron increased the inductance of the coil to a much greater extent than its resistance. When attempts were made to use such cores for coils required for higher radio frequencies, however, they were found to be a disadvantage, and the best design of coil for use in the medium broadcasting band of frequencies has been found to be a single-layer air-core solenoid of suitable proportions of length to diameter.

In the *Wireless World* of September 16 an announcement was made of the production in Germany of a new magnetic material named "Ferrocart", which may have a considerable influence on the design and construction of inductance coils for, at any rate, moderately high radio frequencies. Details as to the exact composition and the mode of manufacture of this material are not yet available, but paper laminations appear to be used to carry the dust core, and the result is a decided improvement upon the old form of core with iron particles. Also a considerable advantage is obtained from the fact that "Ferrocart" can be made up in the form of annular rings for use in the toroidal type of inductance coil. In this manner the air path of the magnetic field of the coil is reduced to a minimum; and since there is less external stray field, the screening of coils in a receiver or other piece of apparatus is rendered an easier problem. In the "Ferrocart" coil the inductance is obtained with considerably fewer turns than is necessary when an air core is used, so that it becomes possible to make the coils quite small while still retaining thick or multi-stranded wire to ensure low copper losses.

Later issues of the *Wireless World* have contained the results of comparison tests of typical air-core coils with two coils of the new type, the larger of which was enclosed in a screening box about 2 inches long and 2 inches in diameter. At frequencies corresponding to the medium broadcast band of wavelengths, each of the coils gave a considerably better performance than two typical commercial coils of greater dimensions, as used in modern broadcast receivers.

The better of the two "Ferrocart" coils was, indeed, only surpassed by an unusually well-designed air coil using stranded wire wound on a three-inch diameter former, containing two or three times the amount of copper wire and presenting considerable difficulty in screening it without loss of efficiency. It is understood that a firm has already arranged to develop the applications of "Ferrocart" in Great Britain.

Weather Charts of the Northern Hemisphere

THE Deutsche Seewarte, Hamburg, has undertaken to produce on behalf of the International Meteorological Organisation, daily synoptic weather charts covering the whole of the northern hemisphere. It is not intended to produce a synoptic chart differing from those published daily by the British Meteorological Office merely in the size of the area dealt with—the British charts cover only a small portion of the large area between the equator and the northern tropic—but one which shall contain the maximum possible amount of detail. For this purpose, it will be necessary to use more material than is provided by the ordinary international exchange of weather reports by wireless, and consequently these extended weather maps will not be available soon enough for direct use in daily short period weather forecasting. Their indirect value in forecasting may, on the other hand, be very great.

It is the view of many meteorologists that an understanding of the causes of long spells of abnormal weather can only be arrived at by the study of charts of this kind, a study which can be pursued at leisure, working on past weather situations. In the future such extended charts will be available in time for direct use in daily forecasting, but meanwhile the knowledge gained from the study of those now to be prepared should prove valuable in interpreting existing charts in much the same way that knowledge gained from a study of the synoptic weather charts of Europe and the North Atlantic solved some of the difficulties of forecasting from charts covering only a portion of Europe such as were used in most countries until recent years. But it is in the further development of long range forecasting that they are likely to be of the greatest utility. Seasonal forecasting of rainfall has been carried out with some measure of success in India and some other countries by means of equations derived from the theory of correlation, the future rainfall being correlated with various antecedent values of meteorological elements in distant countries. It is possible that the new charts may cause this method to be replaced by other more scientific methods based on a better understanding of the general circulation of the atmosphere.

It is hoped to begin the series with the period

of the International Polar Year 1932–33. In order that an idea of the probable number of purchasers may be gained, and that matters may be so arranged that the publication shall be developed into a permanent institution, the Deutsche Seewarte, Hamburg, would be glad to hear in advance from anyone who is likely to place orders for the new charts, and is prepared to submit sample charts and supply any information required. The cost of publication has to be covered by the sale of the charts, and the enterprise therefore depends for its success upon there being a sufficient number of purchasers to keep the price of the individual charts reasonably low.

University and Educational Intelligence

CAMBRIDGE.—Dr. H. R. Hulme, of Gonville and Caius College, has been elected to an Isaac Newton studentship, and W. E. Candler, of Trinity College, and R. H. Stoy, of Gonville and Caius College, have been elected to additional Isaac Newton studentships tenable for one year.

OXFORD.—The electors to the Hope professorship of zoology propose shortly to proceed to the election of a successor to Prof. E. B. Poulton, who has resigned as from January 1, 1933. The resignation of Prof. Poulton, who has held the chair for forty years in succession to the first Hope professor, the late J. O. Westwood, is greatly regretted. It is understood, however, that he intends still to carry on in the Hope Department those researches which have had such fruitful results, especially in the field of insect bionomics.

WALES.—It is stated in the annual report of the Council of University College, Swansea, that the capital deficit of the College has now been extinguished. There is urgent need for a new library, and the Council has decided to raise funds for the provision of a permanent building. It is proposed to issue private appeals for this purpose. The College has established a metallurgical research council to conduct investigations into problems which concern the chief industries of the region.

A STUDY of the place of physical education and hygiene in the curricula of teacher-training institutions has been published as Bulletin No. 10 of 1932 of the United States Office of Education. It is increasingly recognised that the effectiveness of teaching is dependent on the physical health of both teacher and taught, and in about half of the States teacher-training institutions are required by law to include physical education in their general curricula. In some of the States all applicants for teaching positions are required by the State boards of education to present credentials in physical education and health education. In West Virginia physical education is given a prominent place in all types of certificates granted by training colleges. The report directs attention to the fact that a successful programme of health education and physical education is not easily organised or measured in terms of clock hours of instruction or semester hours of credit and that nearly all training colleges provide opportunities for additional physical activities other than those prescribed, including 'hikes', week-end excursions and camping expeditions.

Calendar of Geographical Exploration

Nov. 13, 1876.—Doughty's Wanderings in Arabia

Charles M. Doughty started from Muzeyrib on his two years of wandering in Arabia. His "Arabia Deserta" has been described by D. G. Hogarth as the "Georgic of the Desert"; he characterised surely, sensitively and for all time the immemorial tribal life of the steppe and desert. He wandered as the poorest of the poor among the Bedawin tribes and faithfully and in minutest detail recorded their life and that of the oasis towns. He had been fired with ambition to visit Arabia when wandering in 1875 in the country beyond Jordan. Refusing even to pretend to forswear his faith, he openly travelled as a Christian and, though often persecuted, yet achieved his aim and attained the last station on the pilgrim route to Mecca. His unique journey resulted in contributions to geographical knowledge and to literature; it also gained for him a great reputation with Semitic scholars for the copies and drawings of the Nabathaean and Himyaritic scripts which he obtained.

Nov. 14, 1770.—Sources of the Blue Nile

James Bruce reached the source of the Blue Nile. In June 1768 he arrived at Alexandria, thence he visited Thebes and crossed the desert to Kosseir. He sailed to Jidda and after a stay in Arabia re-crossed the Red Sea, landed at Massawa and finally reached Gondar, the capital of Abyssinia. There his medical skill procured him the support of the Queen Mother, a very useful ally during his troubled stay in Abyssinia. On October 28, 1770, he left Gondar and, from the top of a gently rising hill on which was the church of St. Michael of Geesh, viewed the sources of the Blue Nile. On his return to Gondar political difficulties detained him until December 1771, but then he was allowed to return by Sennar to Nubia. In the Nubian Desert, sand storms and thirst so oppressed the party that the notes and observations of his journeys were discarded, though fortunately Bruce later recovered them. He reached Cairo in January 1773. Bruce was disappointed that the source of the Blue Nile was not considered, as he himself considered it to be, the real source of the Nile. Moreover, the source of the Blue Nile had been previously visited by the Jesuits. Thus the importance of his journey was rather that he re-discovered these regions and in so doing attracted the attention of his generation to African exploration. The five volumes in which he gave his experiences remain a vivid picture of travel in these regions and give much information about the geography, history and social customs of Abyssinia.

Nov. 14, 1805.—Finding a Route Across the Rockies

Capts. M. Lewis and W. Clarke reached the mouth of the Columbia River. They had left the Missouri in May 1804, wintered with the Mandan Indians, resumed the journey up the Missouri, crossed the Rockies and reached the Columbia River, where they wintered. In March 1806 the party divided, Lewis going via the Lolo Pass and thence carrying out certain explorations, while Clarke proceeded to the Yellowstone at its nearest approach to the three forks of the Missouri. They met again on the Missouri and reached St. Louis in September, 1806. The outward journey was calculated at 4134 miles, and Lewis's shorter return journey at 3555 miles from the mouth of the Missouri to the Pacific. They had been

commissioned to explore the Missouri from the point of view of the most direct and practicable water communications across the continent to the Pacific for commercial purposes. They achieved this object and also helped to attract traders to the regions west of the Mississipi by their accounts of possibilities of development.

Nov. 14, 1917.—Philby in Arabia

H. St. J. B. Philby arrived in the Gulf of Bahrain on a political mission to Riyadh, in the course of which he crossed the country from Ojair to Jedda, returned to Basra and once more set out to Riyadh. Thence he journeyed south to Wady Dawasir, thus penetrating some distance into the Nejd. In 1920–22, Philby crossed from Amman to Kabala near the Euphrates. With him went Major A. L. Holt, who had already made extensive surveys between Bagdad and Haifa. Philby's greatest Arabian exploit, however, was the crossing of the Rub' al Khali, the great waterless southern desert, in the early months of 1932. Starting from Hufuf on Jan. 7, he succeeded in reaching Sulaiyil, covering 1800 miles in 90 days. Finds of flint implements and freshwater shells indicated the site of an old riverbed or lake at Bir Maqran, and at Wabar craters of meteoritic origin were discovered. The first crossing of this desert, though by a different route, was in 1931, by Mr. Bertram Thomas.

Societies and Academies

LONDON

Royal Society, Nov. 3.—J. Mellanby: Secretin. Secretin may be prepared from the duodenal mucous membrane by (*a*) extraction with absolute alcohol, (*b*) precipitation by dilute acid, and (*c*) resolution of the precipitate in acid alcohol and precipitation by acetone. The product has the percentage composition of a sulphur-containing protein. It is soluble in water but insoluble in dilute acid. The physiological actions of secretin are: (*a*) the production of a copious secretion of pancreatic juice, (*b*) the contraction of intestinal muscle, and (*c*) the secretion of a small quantity of bile.—**Margaret Hill and A. S. Parkes:** Studies on the hypophysectomised ferret (1, 2, 3). Hypophysectomy of the male during the breeding season (June) caused regression to the anœstrous condition in about a month; the regression being characterised by decrease in testis weight and by aspermatogenesis. The experimentally produced degeneration is about three times as rapid as the normal decline into anœstrus. In the female ferret, removal of the pituitary body about two hours after the beginning of copulation did not inhibit ovulation, which occurs in the normal animal about 36 hours after mating. It would thus appear that some ovulation-producing substance is secreted by the anterior pituitary body within two hours of the beginning of copulation. The corpus luteum, however, failed to develop, and there were no signs of pregnancy or pseudo-pregnancy.—**J. D. Gillett and V. B. Wigglesworth:** The climbing organ of an insect, *Rhodnius prolixus* (Hemiptera; Reduviidæ). It is present in both sexes of the adult, but is absent in the nymphs. It occurs on the distal end of the tibia of the anterior and middle pairs of legs. It enables the insect to climb upwards on clean glass at almost a right angle, but it is of little use in the reverse direction. The organ is a little oval sac of pliant chitin filled with blood. On its lower surface it bears about 5000 tubular hairs, 1 μ in diameter, which appear to be the outlets of unicellular glands producing an oily secretion. At their free ends the anterior surface of these hairs is cut away obliquely so that only their hind margin comes in contact with the surface as the insect climbs. Among these hairs are about 50 delicate tapering hairs arising from large sockets and projecting slightly beyond the others. These appear to be sense organs. They are surmounted by a spindle-shaped mass of cells giving off a nerve fibre.

Physical Society, Nov. 4.—M. Fahmy: A further point of analogy between the equations of the quantum theory and Maxwell's equations. A previous paper (*Proc. Phys. Soc.*, 43, 124; 1931) dealt with an analogy between the electromagnetic equations in free space and the equations of the quantum theory, exhibited by means of five-dimensional geometry. In the present paper the analogy is pursued further and leads to the Eddington relation between the number of electrons in the universe and its radius.—**Lewis F. Richardson:** Time-marking a kathode-ray oscillogram. Time-marks have been arranged as little blurs or gaps in the trace, by periodically unfocusing the electron stream. The current in, and voltage across, a conductor can thus be recorded together with the time on a single oscillogram.—**T. C. Richards:** The elastic constants of rocks with seismic applications. The results of a geophysical survey by means of the seismic method over a large oil-bearing limestone structure in south-west Persia indicate that the limestone possesses a higher elastic velocity at its lower boundary than at its upper. Specimens of the limestone at different depths obtained by 'coring' do not give the same elastic constants when measured by a simple optical method, and the bearing this result has on the practical seismic observation is discussed.—**L. R. Wilberforce:** A common misapprehension of the theory of induced magnetism. It is usually stated that if any given magnet is immersed in a medium of permeability μ the magnetic field around it is similar to that in a vacuum, but diminished in strength in the ratio of $1 : \mu$. This statement is inconsistent with the ascertained experimental laws of induced magnetism.

PARIS

Academy of Sciences, Oct. 3 (195, 565–588).—Ernest Esclangon: The total eclipse of the sun of August 31, 1932, observed in the United States and in Canada. In spite of some cloud, good spectrographs of the corona were obtained, also some excellent general photographs of the corona.—**Lucien Daniel:** The experimental production of small bulbs in the leek.—**Claude Chevalley and André Weil:** An arithmetical theorem on algebraical curves.—**Nikola Obrechkoff:** A general method of summation of divergent series.—**D. Riabouchinski:** Some considerations on the hydrodynamical interpretation of the periodicity of sunspots. An account of experiments with a glass globe containing water, rotating on its axis and containing a stirrer rotating in the same direction, but faster than the globe. Some air was admitted to the globe and photographs are reproduced showing the internal movements. The theory of J. Wilsing on the constitution of the sun is discussed from the point of view of these experiments.—**Louis de Broglie:** Remarks on the magnetic moment and moment of rotation of the electron.—

J. Gilles: The intensities of the components of the hyperfine structure of the most intense lines of the visible spectrum Hg I. The hyperfine structure of the term (Hg 199)7^3D_2.—J. Durand and E. Raguin: The granite of the region of Pinet (Aveyron).—D. Montet: The action of radioactivity in plant physiology. The experimental conditions necessary to prevent confusion between the effects of catalysis and radioactivity are indicated. The use of a salt possessing manurial effects, such as a nitrate, should be avoided.—René Petit: The magnification of correcting glasses.—F. Vles and A. de Coulon: New experiments on the rôle of the electrostatic conditions in the appearance of spontaneous cancers in mice.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 525–565, Aug. 15, 1932).—Lester S. King and Clyde E. Keeler: Absence of corpus callosum, a hereditary brain anomaly of the house mouse. Preliminary report. The character segregates sharply, is probably inherited as a unit character, is not sex-linked and is not due to the presence of the rod-less gene.—T. R. Hogness and R. Ruth Comroe: A search for evidence of the radioactive decomposition of barium. Working on the idea that barium might dissociate into xenon and helium, five rock specimens, all probably of Palæozoic age, were disintegrated and the residual gases examined. No xenon was found spectroscopically. By the method used, 10^{-7} c.c. or about 3×10^{12} atoms of xenon could have been detected. Hence it is calculated that, if barium is radioactive, its half-life period is not less than 10^{15}–10^{18} years.—W. H. Rodebush and W. C. Klingelhoefer: The reaction of chlorine with hydrogen. Atomic chlorine has been prepared and its reaction with hydrogen gas investigated at low temperature.—James H. Hibben: An investigation of intermediate compound formation by means of the Raman effect. Evidence was obtained for the formation of compounds in solution between aluminium chloride and ethyl alcohol, and zinc chloride and methyl alcohol, and for polymerisation of aluminium chloride in water.—Sylvia M. Mills: (1) Double innervation of melanophores. When an area on a specimen of *Fundulus heteroclitus* was denervated, a few of the melanophores which expand over a black background fail to contract over white. Response to electrical and mechanical stimulation also suggests double innervation.—(2) Neuro-humoral control of fish melanophores. The melanophores of a denervated region show a progressive lag, greatest at the centre of the region, in their responses to stimulation. Similar results were obtained with an isolated tail. It is suggested in explanation that melanophore nerves, when stimulated, produce a secretion causing melanophore contraction; this secretion is probably not carried in the blood system.—Arthur Bramley: Gamma radiation. A theoretical discussion using an oscillator which accounts for the needle-like character of the radiation field for very high frequencies.—Chester Stock: An Upper Oligocene mammalian fauna from southern California. The fauna of the Sespe beds of Kew Quarry, which occurs to the west of the Simi Valley, Ventura County, California, is more advanced than that from the Sespe beds north of the Simi Valley (NATURE, 130, 675, 1932). Its age is considered to be not later than Lower Miocene or earlier than Upper Oligocene.—A. D. Michal and J. L. Botsford: (1) An extension of the new Einstein geometry. Developments of the paper by Einstein and Mayer on "Unified Field Theory" (1931).—(2) Simultaneous differential invariants of an affine connexion and a general linear connexion.—S. S. Wilks: The standard error of a tetrad in samples from a normal population of independent variables. An exact expression is derived but it is said to lead to very complicated results.

Forthcoming Events

MONDAY, Nov. 14

UNIVERSITY OF LEEDS, at 5.15.—Prof. H. H. Swinnerton: "Fossil Clues and Hereditary Problems".

ROYAL GEOGRAPHICAL SOCIETY, at 5.—"Early Maps of Great Britain". E. Heawood: "The Tschudi Map"; Miss J. B. Mitchell: "The Matthew Paris Maps"; R. A. Pelham: "The Gough Map".

TUESDAY, Nov. 15

CHADWICK PUBLIC LECTURE, at 5.15—(at the Royal United Services Institution, Whitehall).—Sir Pendrill Varrier-Jones: "The Employment of Tuberculous Patients".

BRITISH INSTITUTE OF PHILOSOPHY, at 8.15—(at University College, Gower Street, W.C.1).—Sir Arthur Eddington: "Physics and Philosophy".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. E. J. Garwood: "Kangchinjunga".

BRITISH PSYCHOLOGICAL SOCIETY, at 8.30.—A. H. Seymour: "The Borderland between Education and Industry".

WEDNESDAY, Nov. 16

BRITISH ACADEMY, at 5—(Annual Lecture on a Mastermind).—Prof. James Gibson: "Locke".

ROYAL METEOROLOGICAL SOCIETY, at 5.—J. Edmund Clark, I. D. Margary, R. Marshall and C. J. P. Cave, "Report on the Phenological Observations in the British Isles, December 1930 to November 1931".

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.30.—Discussion on "The Law of Priority in Nomenclature," to be opened by Prof. W. A. F. Balfour-Browne.

THURSDAY, Nov. 17

CHEMICAL SOCIETY, at 8.—Discussion on "Combustion of Gases in Electric Discharges", to be opened by Prof. G. Ingle Finch.

BEDFORD COLLEGE FOR WOMEN, at 5.15—(Stevenson Lecture).—Sir Josiah Stamp: "The Relation of Finance to Rationalisation".

UNIVERSITY COLLEGE, LONDON, at 5.30.—Sir Charles Sherrington: "Reflex Action" (succeeding lecture to be announced later).

FRIDAY, Nov. 18

ROYAL INSTITUTION, at 9.—Dr. R. G. Canti: "Cultivation of Living Tissue Cells".

Official Publications Received

GREAT BRITAIN AND IRELAND

Report for 1931 (No. 40) on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Annual Report of the Marine Biological Station (No. 45) at Port Erin, Isle of Man. Edited by Prof. James Johnstone and Dr. R. J. Daniel. Pp. 169+7 plates. (Liverpool: University Press of Liverpool.) 6s.

Third Annual *Reports* of the National Radium Trust and Radium Commission, 1931–1932. Pp. 48. (London: H.M. Stationery Office.) 9*d*. net.

Air Ministry: Aeronautical *Research* Committee: Reports and Memoranda. No. 1471 (T.3247): A Flight Path Recorder suitable for Performance Testing. By R. P. Alston, D. A. Jones and E. T. Jones. Pp. 8+8 plates. 9*d*. net. No. 1473 (T.3250): Graphical Solutions for Inviscid Flow. By Dr. H. F. Winny. Pp. 16+4 plates. 1*s*. net. No. 1462 (Strut. 68): Method of Testing Strength and Stiffness of Large Wing. By I. J. Gerard. Pp. 5+5 plates. 6*d*. net. No. 1467 (T.3255): Applications to Aeronautics of Ackeret's Theory of Aerofoils moving at Speeds greater than that of Sound. By Prof. G. I. Taylor. Pp. 7+5 plates. 6*d*. net. (London: H.M. Stationery Office.)

Proceedings of the Society for Psychical Research. Vol. 41, Part 127, October. Pp. 61-88. (London: Society for Psychical Research.) 8s.

Eton College Natural History Society. Annual Report 1931-32. Pp. 44+5 plates. (Windsor.)

Proceedings of the University of Durham Philosophical Society. Vol. 9, Part 1, June. Pp. iv+46+viii. (Durham.) 5s.

Philosophical Transactions of the Royal Society of London. Series B, Vol. 221, B479: A Persian *Sigillaria*. By Dr. A. C. Seward. Pp. 377-390+plates 34-35. (London: Harrison and Sons, Ltd.)

University of London: University College. Calendar, Session 1932-1933. Pp. lxxviii+xii+561. (London: Taylor and Francis.)

Journal of the Royal Microscopical Society. Series 3, Vol. 52, Part 3, September. Pp. xvi+253-342. (London: Royal Microscopical Society.) 10s. net.

The North Staffordshire Field Club. Transactions and Annual Report, 1931-32. Vol. 66. Edited by the Rev. E. Deacon. Pp. 203+A51-A74+8 plates. (Stoke-on-Trent.) 7s. 6d.

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. Trials with Pedigree Strains of Herbage Grasses. (Series H, No. 13, Seasons 1926-1931.) Pp. v+121+8+3 plates. (Aberystwyth.) 5s.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1466 (Ae. Techl. 616: F.M.71): Velocity Distribution in the Neighbourhood of a Corrugated Sheet. By R. Houghton. Pp. 5+4 plates. (London: H.M. Stationery Office.) 6d. net.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (New Series), No. 9, September. Abstracts Nos. 1580-1761. Pp. 291-326. (London: H.M. Stationery Office.) 1s. net.

National Laboratory for Psychical Research. Bulletin 3: The Identification of the "Walter" Prints. By E. E. Dudley. Pp. 16+8 plates. (London: National Laboratory for Psychical Research.) 2s. net.

Battersea Polytechnic, London, S.W.11. Report of the Principal for the Session 1931-32. Pp. 43. (London.)

Ministry of Agriculture and Fisheries. Salmon and Freshwater Fisheries: Report for the Year 1931. Pp. 48+2 plates. (London: H.M. Stationery Office.) 1s. net.

The Choice of a Career. Pp. 16. (London: National Institute of Industrial Psychology.) 3d.

Ordnance Survey. Professional Papers, New Series, No. 14: Paper read at the British Association Meeting of 1932 on The Subsidence of London. Pp. 13+17 plates. (London: H.M. Stationery Office.) 2s. 6d. net.

Proceedings of the Geologists' Association. Edited by G. S. Sweeting. Vol. 43, Part 3, 25th October. Pp. 201-276. (London: Edward Stanford, Ltd.) 5s.

Census of Nigeria, 1931. Vol. 4: Census of Lagos. By H. N. G. Thompson. Pp. ii+53+3 maps. (London: The Crown Agents for the Colonies.) 6s.

Ministry of Agriculture and Fisheries, Department of Agriculture for Scotland, and Ministry of Agriculture for Northern Ireland. Reports on the Work of Agricultural Research Institutes and on certain other Agricultural Investigations in the United Kingdom, 1930-1931. Pp. 377. (London: Ministry of Agriculture and Fisheries.)

OTHER COUNTRIES

Scientific Publications of the Cleveland Museum of Natural History. Vol. 4, No. 1: Descriptions of New Birds from Oregon, chiefly from the Warner Valley Region. By Harry C. Oberholser. Pp. 12. (Cleveland, Ohio.)

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Pylons and Pipelines

THE conspicuous network of high tension cables which is being spread criss-cross about the countryside may serve to remind us of the far greater ramifications of gas pipes and cables underground. Indeed, the streets of the cities of the world are as busy transporting material below the surface as above it, whilst in some lands, notably in America, pipelines carrying natural gas run across the countryside for great distances.

To-day there is increasing competition between gas, electricity and raw coal as sources of heat : all three use the product of the mine as their starting point. In the gas industry selected coals are carbonised so as to give a maximum yield of gas and a solid fuel—coke. In the electrical industry, low grade coal is burnt in highly efficient boiler plants and the steam produced converted in turbines into electrical energy. The domestic user of forty million tons of coal per annum burns specially large or lump coal mined for the purpose, the smalls, so-called slack, being burnt under industrial boilers. By means of pipes and cables, gas and electricity are carried directly into every room of the consumer's house ; he only has to turn a tap or pull a switch to obtain service from them : the advantage over coal is overwhelming. It is not necessary for him to keep stocks of either : there are no ashes to be removed by hand : they produce neither dirt within the house nor smoke without. On the other hand, coal has to be transported by train to the local depot, by cart to the house cellar, by hand in buckets to the room, and it is applied again by hand to the fire at irregular intervals. Gas fire and electric stove burn regularly and at constant efficiency : the coal fire burns with very variable efficiency.

For water heating, central heating, and similar purposes coal is replaced by coke, a product of the gas industry which, now that it is made under close supervision and delivered as a high-class material, low in ash and moisture content and regular as to size, has proved to be admirably adapted for the purpose : stoves fired with it require a minimum of attention. Such heating can also be done with gas or electricity, working under thermostatic control, the economics of the operation depending on their price.

A serious competitor of the three methods of heating based on coal is imported oil, firing by which is likewise automatic in its operation. Both for industrial boilers and for public and private

central heating, oil fuel is continually making headway.

The use of raw coal is in fact unscientific and 'unmodern': it also brings with it all the evils of the smoke nuisance, dirty and dismal cities, and consequent ill-health. Many would abolish it by legislation, yet somehow the coal fire survives, partly for psychological reasons, partly because of the capital cost of replacing it, and partly also because, to the man who burns it in anything like an efficient grate, it is still the cheapest source of heat.

Gas and electricity are still too dear in most parts of Great Britain, not because of any lack of technical efficiency, leading to high production costs in either industry, but to the high cost of all that is comprised under distribution charges. Although both industries are making progress, and must continue to do so as they are continually modernised, the price factor is still the determining one in their more general utilisation. Users economise with them and do not use them as freely as their value merits. With more reasonably priced fuel there would be far less parsimony and better health. By his invention of the steam turbine the late Sir Charles Parsons halved the cost of generating electricity: the cumulative inventions of this century in the gas industry have probably had nearly the same effect.

In the coal trade likewise the distribution costs are far too high: in no other basic commodity does the price at the source bear so small a proportion to the price delivered to the householder. Some day perhaps house to house deliveries by one firm only in a given street on a particular day will become obligatory, as it should be with the essential food services. We add enormously to the cost of living by neglecting such elementary economies.

The coal industry could do much to help the situation. Never was any policy more shortsighted than the decision taken when statutory coal prices were fixed, to mulct the gas and electricity companies in extra charges because they were able to pay the same. It is senseless to seek to establish permanence for a price from gas companies which is higher than that got from other users of precisely the same brand of coal. It would be far more to the interest of the mines to give minimum rates to these industries, with the certainty that at lower prices they could greatly increase their sales and hence their consumption of coal.

The fight between home coal and imported oil is becoming very acute: it is certain, for example, that another coal strike would nearly eliminate coal from factory boilers. The coal industry must realise that the day of raw coal, either on land or at sea, is passing and coal must largely be burnt in such a manner that the energy in it reaches the former customer in a more up-to-date form. The whole technique of mining requires re-examination from this point of view: it should generally be possible to mine a coal of the best size for a particular use, and not add to the mining costs by specially bringing large coal to the surface.

A dangerous competitor of the coal industry for the generation of electricity is water-power, though fortunately for the mines this is as yet but little developed in Britain. It has been calculated that in Europe the progressive expansion of water-power is annually displacing 5 million tons of coal, whereby annually 5000 miners become superfluous.

Fortunately again for the coal industry, we have practically no natural gas in Britain—this now substitutes 78 million tons of coal in the United States. Of the 100,000 miles of pipelines in that country 65,000 miles are used to convey natural gas, individual lines being upwards of 1000 miles in length.

There has developed very rapidly in the United States a use for the propane and butane fractions which can be scrubbed out of natural gas and are sold liquefied, either in cylinders or in pressure tank cars. Propane is used in individual farms and houses where towns gas is not available. The sales of the liquefied gas have increased at a very rapid rate: they were 18 million gallons in 1930 and 28 million gallons in 1931, and the number of customers served with propane was 117,000 in 1930, as compared with 55,000 in 1929 and 20,000 in 1928. The use of the butane fraction has developed along the lines of establishing central stations in communities too small to support a gas works. Butane is mixed with air, and the resulting mixture distributed and metered to residents in the settlement in the same way as towns gas. In this way the remote countryside has all the advantages of gas enjoyed by the dweller in the city and at a comparable price.

The development of the use of gas in cylinders has brought to the front again the question of gas as a motor fuel: in Britain important experiments are in progress to this end. On the test bench, the maximum power output of a standard low compression engine when running on towns gas as

compared with petrol is 88 per cent, and by either increasing the compression ratio or enriching the gas with benzol, it will be possible to raise the maximum power when running with gas almost to that obtainable with petrol. A test vehicle is being run on the road with special steel cylinders of light construction, containing gas at a pressure of 3000 lb. per square inch : these are well within the range of metallurgical technology, and their construction can no doubt be cheapened when the occasion arises. Even more progress in trying out gas has been made in France with satisfactory results.

Should these experiments be successful a new era in motoring would arise in Britain, with an equally great repercussion on the gas industry. The organisation of a chain of compressing and filling stations would not present any insuperable difficulties. In particular, the makers of gas of high calorific power would come into their own, as this would afford additional mileage without refilling, though probably some agreed standard gas would have to be furnished throughout the country, so as to avoid the necessity of adjusting the proportion of gas to air supply on engines of motor vehicles. Undoubtedly also, engines burning gas could be so designed as to give complete combustion, thus avoiding the large proportion of carbon monoxide which is at present produced from petrol.

The running of motor vehicles on gas made from British coal would have a profound effect on the gas industry, which with the increased make would be able to lower its price for gas to the householder. The railways, too, would once more have a large quantity of coal to transport. Surely the effort to solve this problem is worth making by all parties, including the mines. If, as at present, they continue to hold gas and electricity up to ransom, they are eventually doomed.

Equally useful to the mines would be the solution of the motor car fuel problem on quite other lines, for example, the discovery of a dry cell of large capacity which could be quickly recharged at local filling stations. Such an invention is by no means beyond the bounds of possibility.

Dr. A. E. Dunstan, in his brilliant summary of fluid fuels to-day and to-morrow delivered before the Society of Chemical Industry, considers that the coal era will be succeeded first by an oil era, then by a gas era, and finally by an electricity era, coal of course being the primary basis for the two latter. To-day coal is still responsible for seventy per cent of the power produced in the world. Great Britain has coal but no oil ; the use of oil to-day is outstripping that of coal. It will continue to increase as the Diesel engine is perfected, unless more coal is burned in the modern way.

We, at all events, must rush through the oil era and reach that of gas without delay. Let our pylons and pipelines be significant of the will to do this, otherwise tank farms will replace winding shafts on the landscape.

Large Molecules

Die hochmolekularen organischen Verbindungen—Kautschuk und Cellulose. Von Prof. Dr. Hermann Staudinger. Pp. xv + 540. (Berlin : Julius Springer, 1932.) 52 gold marks.

PROF. STAUDINGER'S book on "Large Organic Molecules" is based upon a series of sixty-nine papers on "Highly-polymerised Compounds" and thirty-nine papers on "Isoprene and Caoutchouc" which have been issued during the period 1920–26 from Zurich, and during the period 1926–32 from Freiburg, as a record of researches carried out under the inspiration and control of the author. No attempt has been made to cover the whole field, and in particular the large molecules of the proteins have not been considered. Nevertheless a very clear general idea emerges from the detailed experiments of which a summary is now given. The author is in fact a real organic chemist, who believes in real bonds, and is prepared to extend indefinitely the conception of homopolar molecules, in which *all the atoms are held together by normal covalences.* This idea follows logically from his observations on the progressive polymerisation of compounds such as :

(i) Polyoxymethylene,

$$CH_2O \longrightarrow -CH_2-O-(CH_2-O)_x-CH_2-O-$$

(ii) Polystyrol,

$$\overset{\overset{\displaystyle C_6H_5}{|}}{CH}{=}CH_2 \longrightarrow -\overset{\overset{\displaystyle C_6H_5}{|}}{CH}-CH_2-(\overset{\overset{\displaystyle C_6H_5}{|}}{CH}-CH_2)_x-\overset{\overset{\displaystyle C_6H_5}{|}}{CH}-CH_2-$$

(iii) Polyvinylalcohol,

$$\overset{\overset{\displaystyle OH}{|}}{CH}{=}CH_2 \longrightarrow -\overset{\overset{\displaystyle OH}{|}}{CH}-CH_2-(\overset{\overset{\displaystyle OH}{|}}{CH}-CH_2)_x-\overset{\overset{\displaystyle OH}{|}}{CH}-CH_2-$$

(iv) Sodium polyacrylate,

$$\overset{\overset{\displaystyle COO'Na^{\cdot}}{|}}{CH}{=}CH_2 \longrightarrow -\overset{\overset{\displaystyle COO'Na^{\cdot}}{|}}{CH}-CH_2-(\overset{\overset{\displaystyle COO'Na^{\cdot}}{|}}{CH}-CH_2)_x-\overset{\overset{\displaystyle COO'Na^{\cdot}}{|}}{CH}-CH_2-$$

In all these cases the early stages of polymerisation obviously depend on the formation of covalent molecules, and it would be illogical to set any limit on the length to which the chains of carbon atoms may be extended when the conditions are favourable.

With this background of experimental facts in his mind, the author has looked round for similar structures amongst natural products and claims to have found them in carbohydrates, such as cellulose, and especially in caoutchouc. Thus he supposes that the molecule of caoutchouc, of the composition $(C_5H_8)_{1000}$, contains 13,000 atoms, all united by normal covalencies, and has a molecular weight of 68,000. On the other hand, he has prepared a polystyrol $(C_8H_8)_{6000}$, with about 100,000 atoms in the molecule and a molecular weight of 600,000.

These highly polymerised products form a separate group of organic compounds, since the length of the chain necessarily varies in individual molecules and only a statistical average can be determined, whereas in other synthetic products large molecular weights may be obtained by processes which give rise to identical molecules throughout, as in the more complex dyestuffs or drugs. The average length of the 'thread' can, however, be estimated by a variety of methods. The most important of these depends on finding a formula to express the relationship between the length of the thread and the viscosity of a solution of given concentration.

In the case of roughly spherical molecules the 'specific-viscosity' does not depend to any large extent on the size of the molecules, but for thread-like molecules the specific viscosity increases proportionally with the molecular weight, since the ability of the fibres to impede the movement of the fluid increases with the length of the fibres, and would be correspondingly reduced if the fibres were broken up into shorter lengths. The precise form of the relation between viscosity and length of thread is perhaps open to dispute, but the method has proved invaluable in providing a method of estimating (by extrapolation) the length of threads which are too long to be measured by other methods.

The most trustworthy of these other methods depends on attaching some other radical to the ends of the chain. This radical is then estimated quantitatively (as in recent work on the methylation of cellulose and starch) and the proportion of end-group can be used to deduce the length of the chain. This method can only be used in the case of the smaller threads, but when combined with measurements of viscosity it provides data which can be used for extrapolation to greater lengths.

The existence of aggregates, held together by secondary valencies or van der Waals' forces, is freely admitted in the case of soaps and many other substances of moderate molecular weight, which owe their colloidal properties to the formation of micellar aggregates; but no such aggregation is needed to produce colloidal properties in 'eucolloids' containing from 10^3 to 10^5 atoms of carbon in each molecule. The author therefore believes that the thread-like molecules of cellulose or rubber, although aggregated into bundles in the solid state, may be separated completely into individual threads by dispersion in a suitable medium.

This deduction is fully justified by the contrast between the strength of the carbon to carbon bond, either in the diamond or in an organic compound, and the feebleness of the forces by which molecules are held together in the volatile fusible crystals of a typical organic compound. The only question in dispute is therefore the possibility that under some conditions this separation may still be incomplete.

In this respect Prof. Staudinger has put forward a common-sense view, which will be widely welcomed, especially by chemists who have retained their reverence for structural formulæ and their faith in the quadrivalency of carbon. It is indeed an agreeable sign of the times that organic chemistry in the hands of Staudinger, and inorganic chemistry in the hands of Prof. W. L. Bragg, have provided simultaneously such attractive examples of large molecules, constructed in strict accord with the most orthodox theories of chemical structure; and the reviewer can recall few lectures to which he has listened with greater pleasure than that of Bragg to the Mineralogical Society on the "Structure of the Silicates" and Staudinger's lecture to the Solvay Institute on "Large Molecules", when the floor was littered with glucose molecules, in the form of half-inch lengths of match-stick, which he had broken off from his rods and bundles of cellulose molecules.

The present volume will be read with interest as a full account of the story which was then told in such delightful outline.

T. M. L.

Sulphur Bacteria

Sulphur Bacteria: a Monograph. By Prof. D. Ellis. Pp. ix + 261. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) *21s.* net.

THE sulphur bacteria belong to that remarkable group of autotrophic organisms, the members of which have adopted eccentric modes of metabolism in which unusual sources of energy are tapped. In their case it is the partial oxidation of sulphuretted hydrogen, or perhaps rather of the HS′ ion, with formation of free sulphur. At the same time, carbonic acid is reduced and made available as a source of carbon compounds. Nitrogen can be assimilated from ammonium salts. These materials and some mineral salts are all that is required for the continued growth and well-being of the organisms. The group is confined to organisms which have sulphur globules in their cells. The further oxidation of this sulphur to sulphate, which undoubtedly occurs, has not been proved to be connected with the vital activity of the cells. Sometimes the sulphur is excreted and undergoes oxidation outside the cell.

A feature of great interest in the group is the occurrence of coloured organisms (rhodo-thiobacteria) and much discussion has taken place as to the nature and function of the colouring matter. The prevailing opinion appears to be that by its aid the organisms are enabled to utilise the energy of light in the assimilation of carbon from carbon dioxide. The sulphur metabolism of these coloured organisms seems, however, to be the same as that of the leuco-thiobacteria, so that they have two strings to their metabolic bow.

Considerable practical difficulties arise in the study of the group; especially, perhaps, that pure cultures are difficult to obtain and have not yet in all cases been attained and that the organisms are highly pleomorphic.

The author pays great attention to the classification of this large and important group and adopts an original scheme based primarily on a division into the two groups of colourless and coloured sulphur bacteria. These yield between them eleven families, distinguished by differences in morphology and modes of reproduction and ciliation; these again are divided into 23 genera. A full and well-illustrated description is given of the known organisms, and numerous special points of interest are discussed in separate chapters: such as the intimate structure of the cell, irritability, the mechanism of ciliary motion, etc.

Finally, a very complete account is given of the work on the colouring matter of these organisms. This was first investigated by Ray Lankester in 1873, but the composition and relations of the two colouring matters which are present have not yet been settled.

The sulphur bacteria play an important part in Nature in the sulphur cycle, in which the combined sulphur of the amino-acids of the protein molecule is brought, through the stages of sulphuretted hydrogen and free sulphur, into the condition of a soluble sulphate assimilable by plants, to be reintroduced by them into the protein molecule.

All interested in this fascinating subject will find in Prof. Ellis's book a clear and well documented account of all that is known about it. A. H.

World Civilisations

The History of World Civilisation: from Prehistoric Times to the Middle Ages. By Prof. H. Schneider. Vol. 1. Pp. xiv + 360. Vol. 2. Pp. vi + 361–908. (London: George Routledge and Sons, Ltd., 1931.) *42s. net.*

THIS important and well-known book has been translated from the German, quite competently, though with a good many slips in proof correcting. It naturally suggests the still more famous book of Spengler, which it resembles in the wide sweep of its survey, the facility of its comparisons and the insistence on the rise and fall of civilisations. It is, however, a much weightier book for several reasons. In the first place, it is based on a thorough and scholarly study of the materials; Dr. Schneider's knowledge of the early history of all the civilisations he treats—Egyptian, Babylonian, Greek, Roman, Indian and Chinese—is amazing. In the second place, he is not obsessed by the fallacy which commended Spengler's work as a sensation but undermined its real value, namely, that we are in presence of the decadence of our own civilisation. In the third place, Dr. Schneider is a professor of philosophy and hence by his profession and habitual ways of thinking is always trying to see his subject as a whole.

Now, as human civilisation is one great connected process, this is a prerequisite of the highest importance. At the same time it has led the author

into many doubtful positions—one in particular—which have been noticed with marked disapproval by the specialists and are likely to prejudice the public against the high value of the work as a whole, unless they are pointed out and guarded against at starting.

This one most insistent theory is that of the origin of all civilisations from a northern land and northern peoples, who, accustomed to see the sun disappear entirely in the winter and be born again in the spring, conceived a solar religion which Dr. Schneider traces in the mythology of all. The good and supreme Being is in conflict with a treacherous and malign power which for a time subdues him, and then by various devices he is brought back to life and beneficence again. This so-called 'Cimmerian hypothesis' is not of course generally accepted, but it would be a grave mistake to rule out of consideration any light that it may throw on the dark places of primitive man, and the suggestions which Dr. Schneider is able to make on this basis are often surprisingly enlightening.

The other side, on which the book is most likely to arrest the general reader, is the constant tendency to see analogies in the upward course of the various civilisations described. Egyptians are compared with Babylonians at every turn, and Jews with Greeks and Romans. When we reach the final sections of the book, in which India and China are dealt with much more summarily than the more western peoples, this method is predominant. The assumption always is that each civilisation follows a similar course to that of others, in main outline, with differences due to the various endowment and circumstances of each. Assuming the similarity, the contrasting points stand out more clearly and become more significant of the character of the people to whom they are due. Thus the great gods of India, Indra Agni and Varuna, correspond in a general way to those of the Greek mythology as seen in the "Iliad", but in India they are less clearly visualised and less differentiated. As that power was feebler among the Indians, plastic art achieved nothing like the Zeus of Phidias or the Hermes of Praxiteles.

The section on China is specially interesting from this point of view. Treating the Chinese as most like the Greeks, but crediting them with a mainly independent evolution, Schneider finds that Lao Tzu corresponds more or less to Xenophanes and Confucius to Pythagoras. Both teachers approached very closely to the Greeks though they did not quite attain their level. "Lao Tzu's monism was scientifically on a lower plane than Parmenides and Heraclitus and the criticism of Confucius did not culminate in a Socratic method of bringing valuable knowledge to birth." The reader will notice how the method, which may sometimes strike him as fanciful, has the supreme merit of making the whole story alive and fascinating, and if he wishes to criticise or supplement, so much the better.

The book as a whole is a masterly performance and the sequel will be awaited with great interest. The present two volumes bring us down only to the threshold of the Middle Ages. Chu Hsi, who died in 1200, is the last great man touched on in the Chinese section, and treated somewhat cavalierly. The fact that these volumes stop at that point partly explains what will appear to a careful reader the most serious weakness of the book. Exact science, the ordering of their world by what they had ascertained of the laws of Nature, does not receive sufficient attention. There is too much of their theological beliefs, too little of what they were learning and practising all the time about the world they lived in. Let us hope that this will receive due acknowledgment when science was reborn in greater strength after A.D. 1200.

F. S. MARVIN.

The Insect Menace

The Insect Menace. By L. O. Howard. Pp. xv + 347 + 32 plates. (London: D. Appleton and Co., 1931.) 12*s*. 6*d*. net.

DESPITE the fact that human health and happiness rest on biological foundations, it is surprising how slight has been the incorporation of biological knowledge in current public opinion. For this condition of affairs the biologist himself has not been without blame, in that he has failed to realise that none but the trained specialist can hope to understand the jargon of technical terminology, in which his researches are written. Since the general public provides much of the sinews, which make biological research possible, it seems only fair that its members should be provided from time to time with a readily intelligible account of the progress that the biologist is making in solving problems of human import. In no biological field does the stream of research flow so rapidly as in that of entomology, and in this book the author, who successfully directed the affairs of the United

States Bureau of Entomology for many years, sets himself the task of educating the lay mind in the methods by which the entomologist is coping with the depredations of insect pests.

In the initial chapters Dr. Howard explains why insects with their vast range of structural adaptations, extending over a period of forty million years, have achieved such a marked degree of ascendancy over practically all other living organisms save man. It is further shown that the achievement of economic status as pests by insects has been mainly determined by human agency, which has also fostered their spread from region to region and country to country by reason of the facilities offered by modern systems of rapid transport.

If one has any doubts of the extent of the damage caused by insects, the formidable figures —even approximate as they are—furnished by statisticians will go far to remove them. For example, during the year 1919 it was estimated that insect ravages were responsible for a reduction of four hundred million pounds in the value of the crops of the United States alone. It almost staggers the imagination to think of the extent of the losses reckoned in terms of the crops of the whole world. It is readily comprehensible how these losses must and do affect the prices of many staple commodities such as cotton, sugar, maize and wheat as well as the conditions of the labour market in different parts of the world. Then again there is still to be considered that toll of human health and efficiency, to say nothing of domesticated animals, which is exacted by the pathogenic micro-organisms, that are transmitted by insects, blood-sucking and non-blood-sucking, in both tropical and temperate countries.

In view of all the facts, there is cause for congratulation that to-day there are more than seventy countries which have come to realise the importance of applied entomology, and are now providing staffs of trained entomologists, who either act in an advisory capacity or carry on research on specific problems. It is recognised that human resource and ingenuity are being taxed to the utmost to cope with the insect menace. Methods of attack vary with the individual insect species. Now it may be biological, as in the case of the cottony-cushion scale of California and the Levuana caterpillar of Fiji. Again it may be mechanical and chemical, as in the case of the cotton-boll weevil; or again it may be legislative, involving stringent measures of quarantine and eradication, as in the case of the Mediterranean fruit-fly. That solutions of what at one time seemed hopeless problems have been achieved is shown by the present negligible status in the United States of the Rocky Mountain locust, the cotton-boll weevil and the Mediterranean fruit-fly. Elimination of the breeding grounds in the North-West by settlement and cultivation has obliterated the swarms of the first of these; in regard to the second it has been shown that cotton can be successfully grown despite the weevil, if the plants are dusted with arsenate of lime; and the dreaded fruit-fly introduced into Florida in 1929 was speedily eradicated by the destruction of all infested fruit and restriction of shipments of fruit from infested to non-infested areas.

In conclusion, we would say that Dr. Howard has admirably achieved the purpose with which he set out. The educated layman will find no difficulty in following his arguments, and we can guarantee that the reader's interest will be sustained from cover to cover. The book should enjoy a wide circulation among those who are anxious to extend their knowledge of Nature's ways.

A. E. CAMERON.

Short Reviews

A Scheme of Egyptian Chronology: with Notes thereon including Notes on Cretan and other Chronologies. By Duncan Macnaughton. Pp. xii + 406 + 19 plates. (London: Luzac and Co., 1932.) 25*s*.

THE author here follows up certain suggestions in reference to Egyptian chronology which were put forward in his "Scheme of Babylonian Chronology", but were not worked out. Further study has now shown him the possibilities of a number of clues to the dating of the early Egyptian dynasties. His theory, broadly, is that the 'births' of the gods in the Palermo Stone refer to the commencement of planetary cycles, which could probably only occur in historic times at a certain period, reinforced by his interpretation of the evidence of the list of Eratosthenes, and other calendrical and astronomical evidence.

The author himself regards his results as of varying value, some being classed as highly probable and others as only "mere possibilities". The result as regards the crucial dates are certainly high in comparison with more conservative systems. Thus Dynasty I is put at 5776 B.C. as against the 4360 B.C. of Petrie or the 3315 of Meyer. The author is scrupulously fair in the full statement of his data, and even those who do not agree with him, will find his book a useful compendium of the facts relating to the controversial questions of Egyptian chronology.

The Scenery of England: a Study of Harmonious Grouping in Town and Country. By Dr. Vaughan Cornish. Pp. 125 + 8 plates. (London: The Council for the Preservation of Rural England, 1932.) 3s. 6d. net.

DR. CORNISH here presents to us the beauty of England in a succession of charming word-pictures from his rich store of personal impressions of the many types of landscape which the country affords, including the Lakes, the Peak, the Fens, the Cotswolds, Dartmoor, the New Forest, the Dorset coast, Wiltshire downs and many other parts. This, in a book of so modest a compass, should be a more effective method of rousing public interest in the work of the Council for the Preservation of Rural England than a more categorical description of the country, county by county, or district by district. Dr. Cornish throughout lays stress on the importance of making buildings harmonise with the landscape, and he concludes with appendixes on the aims and objects of the Council and powers and duties of affiliated local authorities.

The Council's attitude towards modern developments is thoroughly sane and well-balanced, emphasising the complementary relationship between town and country and the necessity for planning England as a whole, never suggesting that it would be either possible or desirable to hamper the healthy growth of cities. The face of England as regards extent of area is still predominantly rural by a wide margin, and it would no doubt be to the advantage of the nation that it should remain so. Hence it seems to us that the efforts and deliberations of the Council should always be made with an eye to the possibility that the population will continue to increase indefinitely.

If the present huge population of England were ever to double itself and remain concentrated in a few unwieldy 'conurbations', it is difficult to see what could be done to prevent a large fraction of the area of the country from wearing a heavy suburban cloak, even though the remaining rural districts might still be solitary and the remoter mountain regions practically uninhabited wilderness as at present. L. C. W. B.

The Call of the Bush: Wanderings of a Nature Man on the Murray River. By Harold Priest. Pp. 240 + 16 plates. (London: T. Werner Laurie, Ltd., 1932.) 12s. 6d. net.

THIS is the record of a long tramp along the course of the Murray River, the author shifting for himself and 'living on the country' as he went, though he ultimately joined up with a couple of cattlemen and accompanied them for a time. His observations on the great river and the various human and animal types which frequent it are varied and they are interestingly told, but the book would have been even better than it is had there been more detailed natural history and less reflective 'padding'. One interesting observation is on the coloration of the ticks infesting the common Australian monitor (miscalled 'guana' or 'goanna'), which are black when adhering to the black areas of the reptile's skin, and yellow when on the pale ground, and this, as the author says, suggests that this adaptive hue, which renders them very difficult to see, means that they have had to protect themselves against removal by other agencies as well as their hosts. Another interesting fact recorded is that domestic cats kept in the wilds bring their kittens fishes as well as other animals, indicating that the animals' well-known fondness for these has its foundation in a natural preying habit.

Pila (the Apple-Snail). By Dr. Baini Prashad. (The Indian Zoological Memoirs on Indian Animal Types, edited by Dr. K. N. Bahl, No. 4.) Pp. xi + 83. (Lucknow: Methodist Publishing House, 1932.) 2 rupees.

THIS laboratory manual on the snail now studied in most eastern universities as a type of gastropod mollusc is itself a model of what such a book ought to be. It is well illustrated, and contains not only a description of the anatomy of the subject and practical directions for its dissection, but also a synopsis of the eight Indian species of the genus *Pila*, and some interesting bionomical notes. From these it is plain that the apple-snail is the most versatile of the gastropods—or indeed, of all Mollusca. Usually a denizen of fresh-water, it can, in the case at least of *P. globosa*, tolerate that which is brackish; usually vegetarian, it may eat dead animal matter. It has both aquatic and aerial respiration at its command; it can swim as well as crawl in water, and yet can travel overland and even climb trees, while it lays its eggs on land, and specimens left dry in a cupboard rivalled the celebrated desert-snail of the British Museum by being found alive after five years.

The Animals came to Drink. By Cherry Kearton. Pp. 189 + 31 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 6s. net.

IN the introductory note the author states that he would "be thankful if this book could act as a counterblast to the many animal stories, so constantly appearing, which are based on utterly false or distorted natural history", and his desire will certainly be fulfilled if this volume achieves the popularity it deserves. The reader's attention is held from start to finish and the genuine ring of truth is established as, in the form of a story, the writer recalls his own long experience of African wild life. The narrative centres round the wanderings of an *impalla*; the insistent demand for water results in the description of many incidents which show the author's patience and keenness of observation. The volume is well illustrated.

Water Pollution Research

By DR. A. PARKER

THE growth of industry and of the population during the last century, especially in the north of England, gave rise to several undesirable conditions, including gross contamination of rivers, which in some cases became little better than open sewers. A plentiful supply of water of good quality for domestic and agricultural purposes is one of the major factors in public health, and large quantities of comparatively pure water are required for many industrial processes. Available sources, both surface and underground, of unpolluted water are gradually being depleted and there is no doubt that many rivers which are at present polluted will have to be utilised in the future as sources of supply, after treatment, for both domestic and industrial purposes. Further, the problems of river pollution are of importance in that they affect not only the health and recreations of the population but also the interests of farmers, landowners and fishermen. It is not surprising, therefore, that attention has frequently been directed to the need for satisfactory methods of preventing or reducing pollution.

It was recognised by the Royal Commission on Sewage Disposal, whose comprehensive inquiry during the years 1898–1915 produced results of great value, that satisfactory methods of disposal of polluting liquids from industrial operations were in many cases either unknown or impracticable, and that the problems involved could not be solved without further knowledge. One of the recommendations of the Commission was the establishment of a central authority the duties of which should include the investigation of problems in the purification of polluting discharges and the collection and correlation of the results of investigations by others. Since 1915, the importance of the subject has been stressed on several occasions. In February 1927, public opinion was focused on the matter by a deputation, representative of the British Waterworks Association, the Salmon and Trout Association and other authorities, which was received by the late Lord Balfour, then Lord President of the Council. In consequence of the views expressed by these and other independent authorities and by several Government departments, the Water Pollution Research Board was set up in June 1927 by the Department of Scientific and Industrial Research. This Board was appointed to submit schemes for research on the prevention of the pollution of rivers and other sources of water supply and on any relevant matters affecting the purity of water supplies, and to supervise approved investigations.

Since its appointment, the Board has initiated investigations of the problem of disposal of effluents from beet sugar factories, the base-exchange process of water softening, the causes of the corrosive and plumbo-solvent action of certain waters on mains and service pipes, and of bacteriological and physico-chemical problems associated with processes of purification of sewage. In addition, a comprehensive scientific survey of the River Tees was begun early in 1929. The research staff has also assisted other investigators by directing attention to appropriate scientific and technical literature and by indicating the most promising methods of attacking the problems to be solved. In this connexion, informative summaries of current literature relating to water supplies, sewage, trade waste waters, river pollution and kindred subjects are systematically prepared and published monthly.

Of the investigations already mentioned, that dealing with effluents from beet sugar factories and the survey of the River Tees have reached the most advanced stages. It is proposed, therefore, briefly to describe these two investigations and the more important results obtained. Incidentally, as an illustration of the greater interest now being taken in the problems of water supply and river pollution, it should be mentioned that a session of Section B (Chemistry) at the recent meeting at York of the British Association was devoted to a discussion of the survey of the River Tees. In addition, Sections D (Zoology) and K (Botany) held a joint discussion on biological balance in fresh water, while the organisation required for recording water level and river flow in the British Isles was discussed in Section A (Mathematical Science and Physics).

When the Water Pollution Research Board began its activities, the beet sugar industry had only recently developed on an extensive scale in Great Britain, but already several serious cases of the pollution of rivers by the waste waters had occurred. Preliminary work soon indicated that it might be advisable to suggest modifications in the factory processes so as to reduce the quantities or alter the composition of the effluents rather than to consider only methods of purification. It was important, therefore, that the investigation should be proceeded with as rapidly as possible, before other factories were erected.

On arrival at the factory, the beets are conveyed by water carriage along flumes to washers in which they are washed to remove adhering soil and debris. In a factory of average size, 1,000–1,500 tons of beet are dealt with each day and the total quantity of fluming and washing water varies from 2·5 to 3·5 million gallons. After washing, the beets are cut into small slices or cossettes from which the sugar is extracted with hot juice or water, usually in a battery of diffusers; the diffusers are cleaned periodically by washing with water. The spent cossettes are then pressed to reduce their moisture content. Water

removed from the spent cossettes, together with the washings from the diffusers, is generally known as process water and amounts to 300,000–500,000 gallons per day. Purification of the solution of sugar is effected by several processes and the purified juice is evaporated to crystallise the sugar. A large quantity of cooling water is required during the concentration of the juice, and from 75 to 80 per cent of the water in the juice is removed and condensed in the process. The total quantity of water from the condensers is of the order of 3 million gallons per 1,000 tons of beet treated; this water is often used again in the flumes for carrying the beets to the washers. From this brief description of the factory processes, it will be noted that the principal effluents for disposal are fluming and washing water, 2·5–3·5 million gallons per 1,000 tons of beet, and process water, 300,000–500,000 gallons per 1,000 tons of beet. The fluming and washing water carries soil and beet debris and contains small amounts of dissolved organic and inorganic substances. It is definitely polluting in character, but though larger in quantity it is not so objectionable as process water. This latter effluent contains 0·2–0·4 per cent of sugar, ferments rapidly on storage and takes up large quantities of oxygen from any river into which it may be discharged.

As a result of the investigation during 1927–30, the Water Pollution Research Board definitely concluded that by suitable modifications in the factory processes, the whole, or at least the major quantities, of the fluming and washing water and of the process water could be re-used, leaving little or no effluent for disposal. Certain factories have for several seasons re-used the fluming and washing water after simple treatment by screening and sedimentation to remove solid matter, and the re-use of this water has proved to be entirely satisfactory. At some factories the cossettes are extracted by a continuous process of diffusion in which the water removed from the spent cossettes is returned to the diffuser. In this process there is very little waste water for disposal. Even with the intermittent process in a battery of diffusers, large scale trials in the factory have shown that after preliminary treatment with lime or by other simple methods, the process water can in large measure be re-used in place of fresh water. If the fluming and washing water is re-used, then the effluent from the condensers requires consideration. This effluent is not very polluting in character, but it is advisable that it be cooled before discharge to a river, or it may be cooled and re-used.

Although it had been shown that the waste waters from a beet sugar factory could be largely re-used, it was realised that it might be necessary on occasion to discharge a proportion of the waste waters or that some factories might prefer to purify the wastes sufficiently to allow of their discharge into a river rather than to re-use them. After preliminary experiments in the laboratory, it was decided that, as a method of purification, the process of biological oxidation on percolating filters showed promise of success. This process, which is similar to that in operation at many sewage works, was tried therefore in laboratory and large-scale experiments. In addition to the chemical examination of the effluents before and after treatment, the fauna and flora of the filters have been systematically studied, and it has been shown that, under certain conditions, beet sugar factory effluents can be sufficiently purified by biological filtration to allow of their discharge, except into the smallest streams, without causing serious pollution. It has been demonstrated, therefore, that gross contamination of rivers by effluents from beet sugar factories can be avoided and there is no doubt that during the past two or three years this type of pollution has been much reduced.

The survey of the River Tees was undertaken with the object of obtaining more precise information than was hitherto available on the effects of different kinds of effluents, both sewage and industrial, on a river, and with the object of assessing the power of a river to recover from the effects of polluting discharges. This survey provides a good example of what can be achieved from carefully planned co-operation between specialists in different branches of science, for it has included hydrographical, chemical, bacteriological, botanical and zoological observations and experiments. In addition, records of rainfall have been collected for correlation with measurements of river flow.

From the hydrographical measurements, it has been shown that the water in the estuary at depths below one fathom has a tendency to move up river over each tidal cycle of ebb and flood. The water in the top layer, however, has a strong net movement down river, and the volume moving down river in this layer is greater than the net volume moving up river in the lower layers. A circulatory system is thus set up and is superimposed on the to-and-fro movement of the tides. It has been concluded, therefore, that polluting matter is not readily conveyed to the sea unless it is in the surface layer when it reaches the estuary.

Large quantities of crude sewage and of industrial effluents are discharged into the estuary of the Tees, especially in the section from Stockton to Cargo Fleet. The principal industrial effluents are those derived from coke ovens which contain tar acids, naphthalene, cyanide, etc., and spent pickle liquor, which is an acid solution of iron produced during the cleansing of iron and steel. Oxidation of the sewage and effluents occurs in the estuary at the expense of dissolved oxygen. The Tees was formerly a noted salmon river, but for many years large numbers of fish have been killed in the estuary, especially salmon and sea trout smolts during their migration in the spring to the sea. Various observations and experiments

included in the survey have proved that in 1930 and 1931 the death of migrating smolts was not due to the deficiency of dissolved oxygen but to cyanides, which were frequently found in lethal concentrations. Other poisonous substances, including tar acids, were not found in toxic concentrations and it has been concluded that in the absence of cyanides, migrating smolts would not have been killed in 1930 and 1931. This conclusion marks a distinct step forward, for although several explanations had previously been offered, it had never before been suggested that cyanides were responsible for the death of fish in the River Tees. Another interesting result of the survey is that experiments in the laboratory and on a semi-technical scale have demonstrated that cyanides in coke oven effluents can readily be converted into relatively non-toxic ferrocyanide by treatment of the effluents with spent pickle liquor and lime.

In the non-tidal reach of the Tees, there is only one point at which any large quantity of polluting matter enters and this pollution is derived from sewage. Further downstream, for a distance of about 15 miles, there is no polluting discharge of any importance. A study has been made, therefore, of the effects of sewage pollution on the biology of the river and of the factors which influence the rate of self-purification of a river from pollution by sewage. It appears that temperature is the most important factor, so that the rate of self-purification is much greater in summer than in winter. In determining the relative rates of self-purification under various conditions, it has been necessary to calculate the total quantities of different constituents of the river water from the results of chemical analysis and measurements of volumes of water and river flows. The occurrence of certain plants and animals has been correlated with the conditions of the water as determined by chemical analysis and several new and little-known algæ have been discovered. In addition, useful additions to knowledge have been made with regard to the food of fish.

Cod in Danish Waters

COD are present in all Danish North Sea waters and extend northward through the brackish Baltic Sea into the still more brackish Gulf of Bothnia almost (but not quite) to its northern extremity. Elaborate researches upon the cod in all these waters have been carried out by a Danish investigator, Dr. E. M. Poulsen, the results of which have been published recently in a comprehensive report.*

In Section I of the report data regarding the bathymetric distribution of the fish in Danish waters are given. In the North Sea, cod are most abundant in depths of less than 100 metres. Between 100 and 200 metres they are relatively scarce, while at depths of more than 200 metres they are seldom caught. What few cod there are present in these deeper layers are almost entirely old and large fish. In the Baltic, around Bornholm, cod are most numerous from 40 down to 100 metres, at which depths the water is less brackish than in the overlying layers. In the Kattegat, on the other hand, the fish favour depths of from 40 to 60 metres.

Observations on the spawning periods of the cod in these different regions produced very interesting results. In the Kattegat, spawning begins in February, reaches a maximum in March, and finishes about the end of April. In the Belt Sea spawning may extend into the first half of May, while still farther north, in the Bornholm Deep, spawning continues from April until August with June as the main spawning month. Contemporaneous hydrographical data reveal that the cod spawn in water the temperature of which lies between 3° C. and 7° C. The displacement of the spawning season from early spring far into the summer, on proceeding from the Kattegat into the Baltic, corresponds with the different times at which the bottom waters reach this temperature.

Cod larvæ occur throughout the whole of the area investigated, but are most numerous in the North Sea, the South West Kattegat, the Sound, Belts, and Western Baltic, and are relatively very much scarcer in the Skagerak, the North East Kattegat, and in the Baltic proper. The larvæ are peculiarly abundant in front of certain marine ridges which intercept the in-going North Sea currents in the Little Belt, at the Gedser Reef, and at Dragden in the Sound. Hydrographical investigations show that the ingoing salt-water currents are largely blocked at these ridges. Larvæ from the North Sea brought in by the currents are therefore largely intercepted by them and accumulate in great numbers on their seaward sides.

During the period 1917–1927 good and bad survival years for the fry are stated to have alternated regularly, the years 1917, 1919, 1921, 1923, 1925, and 1927 having been good survival years, while the intervening years were bad. The years 1928 and 1929 are described somewhat vaguely as being neither good nor bad but "to some extent normal".

The most interesting and important part of the report is that in which the author records his attempts to determine the causes underlying these annual fluctuations in the abundance of cod fry in these waters. At the outset a certain amount of evidence is put forward which suggests that fluctuations in the number of eggs produced from year to year are not to any appreciable extent correlated with fluctuations in the number of larvæ later produced.

* Erik M. Poulsen. "Biological Investigations upon the Cod in Danish Waters". Meddelelser fra Kommissionen for Danmarks Fiskeri-og Havundersøgelser. Serie: Fiskeri. Bind IX., Nr. 1., pp. 1-148. C. A. Reitzels Forlag, København, 1931.

A distinct correlation is found to exist, however, between the temperature of the bottom waters in March–April–May and the quantity of larvæ which can be caught by standard methods in these months, a relatively high temperature being coincident with a good larval yield and vice versa. The reason for this correlation is claimed to be that temperature conditions are directly responsible for the abundance or otherwise of the planktonic food organisms upon which the fry depend for their survival. The radius of action of a tiny cod larva is very small. If it does not find abundant and easily available food as soon as its yolk is used up it dies.

Dr. Poulsen has also found an apparently significant relation between the temperature of the surface water in January and February and the number of larvæ obtainable in the spring months following. The reason for this, he believes, undoubtedly is that when the surface water in mild winters is comparatively warm the winter minimum of planktonic organisms does not sink so far as in more severe winters. (In this connexion it is interesting to recall that in 1927 Johansen found that the number of plaice fry in the Belt Sea was correlated with the number of days in which the water was covered with ice, and the temperature of the surface water in January and February.)

A definite relation is also established between the salinity of the bottom waters in November and December and the number of fry present in the following spring both in the Belt Sea and to a lesser extent in the Kattegat. This correlation, it is pointed out, cannot be due to any direct influence. Spawning does not begin until January at the earliest and larvæ do not appear until about the end of February. The following tentative explanation is therefore put forward. In the autumn an annual migration of large and sexually mature cod is known to take place from outside into the Belt Sea. This migration is dependent upon an autumn inflow of salt water from the North Sea. The larger the inflow, the greater the number of cod which come in with it. Particularly large numbers of eggs are then spawned and a large brood of larvæ results. At the same time, a large inflow of North Sea water produces a condition of high salinity in the Belt Sea and in the Kattegat.

This explanation implies that fluctuations in the numbers of eggs laid produce corresponding fluctuations in the resulting larval broods. This hypothesis may hold good in the Belt Sea but the author himself, in another part of his report, points out that it does not appear to be true as a general rule. It is to be hoped, therefore, that Dr. Poulsen will continue these researches and that this report will in due course be followed by another containing new and illuminating information on these interesting and important points in the life history of the cod in Danish waters.

G. A. S.

Low Altitude Auroræ

AN unusually low aurora was witnessed on March 8 of this year at the Auroral Observatory, Tromsø, Norway. The height was determined photographically by the Director, L. Harang, working with Dr. W. Bauer (of the Photophysical Laboratory, the Danzig Technical High School), who have made a brief joint report of their work in *Gerlands Beiträge zur Geophysik* (Bd. 37, pp. 109–115, 1932). At the suggestion of E. Brüche, Berlin, two film cameras were in use at the two base stations (43 km. apart) from which simultaneous parallactic photographs were made; this was in order that, by taking short exposures of a few seconds, a continuous record of the development and changes of auroræ might be obtained. On the two evenings of March 8 and 9, 1932, about 500 pairs of photographs of bows, bands, draperies and rays were taken, during intense displays of the northern lights. A series of 20 pairs of these pictures, covering a period of only 75 seconds, on the night of March 8, disclosed a particularly interesting phenomenon.

At 20.45 G.M.T. an intense yellow-green auroral bow with a deep-red lower edge appeared in the north, at an elevation above the horizon of about 13°; it was found to be 290 km. distant, at an altitude of 77 km. Within 40 seconds it drew southwards by 20 km., and penetrated the atmosphere further, to 75 km., while its eastern portion dissolved, so that the bow ceased to be in the field of the camera. Suddenly, during a few seconds, another bow developed, 20 km. behind the first, that is, at the distance where the latter originally appeared; the second bow, however, was lower, its measured height being only 65 km. After 15 seconds its height quickly increased to 80 km., and it receded to 350 km. distance, while the red colour vanished from the lower edge. This bow also then drew slowly southwards, while its right end rose to 100 km.; this disclosed a third faint bow, lying at 90 km. height and 70 km. behind the second one, the gradual southward motion of which it followed. The time during which the second bow was below 75 km. was less than 20 seconds.

The outstanding character of this observation is well illustrated by the diagram here reproduced (Fig. 1), from the paper referred to. In column *A* are shown all the measured heights of the yellow-green auroral bows observed at Tromsø during the period February to October 1929. In the middle column *B* are shown the heights of the red-edged yellow-green bows observed there on March 8, and in column *C* the heights of other yellow-green bows observed on the same evening. The diagram shows that the heights usually exceed 90 km., but, rather rarely, come down nearly to 80 km., as Prof. C. Størmer found. The quite exceptional nature of the lower red-edged

bow of March 8, extending down to 65 km. (or possibly even less) is evident.

We are still ignorant of the precise mode in which the auroral light is produced, but it seems likely to be due to the entry into the atmosphere of charged particles from outside; the sign of the charge, and the speed of the particles, are unknown. Their penetrating power can be conveniently stated (as for α- and β-particles in the laboratory) in terms of the equivalent thickness of air at normal density which they traverse. This cannot be accurately inferred from the measured heights of the lowermost edges of auroræ, because of uncertainties as to the composition and temperature of the air at great heights; but there can be little doubt that particles which come down to 65 km. traverse at least five times as much air as those that come down to 80 km. Thus the newly observed aurora suggests that, at times, particles enter the atmosphere with a penetrating power five times as great as that of those (themselves unusually penetrating) that come down to 80 km. If this interpretation be correct, the extension in the range of our knowledge of these particles is no small one.

Another reflection is prompted by the extremely fleeting nature of this low aurora. Throughout their many years of auroral photography, Størmer, Vegard and Krogness have never measured so low an aurora; of course a great many auroræ the heights of which have not been determined have appeared during this period, and much of their work has been done at stations south of Tromsø. Apart from the red edge, which is not unique, the low bows now measured were not specially outstanding, and there was no obvious indication of their unusually low altitude. May not many such low bows, perhaps equally fleeting, have passed without recognition of their exceptional character? And may there not occasionally be still lower ones to be discovered by some fortunate or patient observer? The answer seems likely to be 'yes'.

Further, every reduction in the auroral heights substantiated by parallactic measurements increases the credibility of the reports of auroræ extending down to the ground. The gap between a height of 65 km. and the ground is a very large one, it is true, but already we have seen the lowermost measured height reduced from 100 km. or 95 km., as in Størmer's early work, to 80 km. in his later work, and, by McLennan's Canadian observations, to 75 km.; and now, by Harang and Bauer, this is brought down to 65 km.—a total reduction of 30 km. The capacity of auroræ to produce low height records—like that of the weather to surpass its own records of long standing—may be much greater than has been supposed.

In this connexion it may be appropriate, finally, to mention that a new collection of reports bearing on the audibility of auroræ, and on low altitude (ground level) auroræ, has been made by Dr. C. S. Beals, of the Dominion Astrophysical Observatory, Victoria, B.C. The reports come from the northern Canadian auroral belt, and are closely similar in tenor to those collected by Mr. J. Halvor Johnson, which I described in an article in NATURE of March 7, 1931. Dr. C. A. Chant, editor of the *Journal of the Royal Astronomical Society of Canada*, had also collected such evidence, during the years 1907–29. Dr. Beals, after discussing the evidence in his paper (which is to appear in January in the *Quarterly Journal of the Royal Meteorological Society*), regards it as reasonably establishing the occurrence, on very rare occasions, both of auroral sounds and of ground-level auroræ.

S. CHAPMAN.

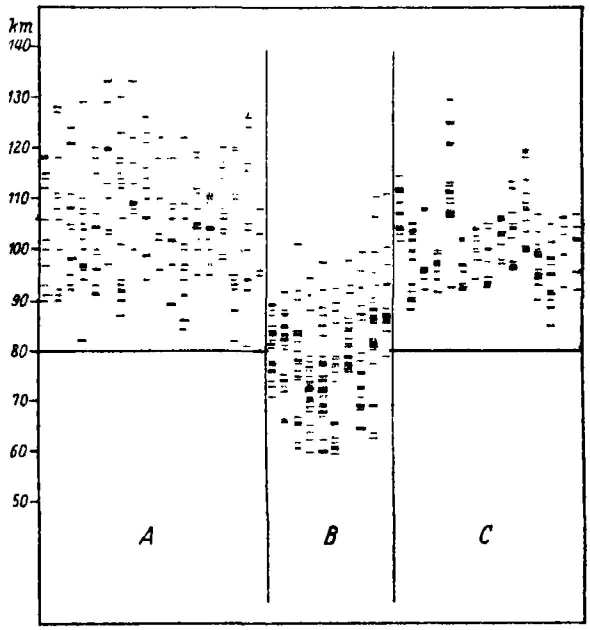

FIG. 1. Heights of auroral bows: *A*, February-October, 1929; *B* and *C*, March 8, 1932. From *Gerlands Beiträge zur Geophysik*, Bd. 37, Heft 1, 1932.

Obituary

PROF. T. GRAY

IT was with profound regret that the many friends of Prof. Thomas Gray learned of his death at Elie, Fife, on September 26. With his passing the Royal Technical College, Glasgow, has lost one of its most distinguished members.

Born at Mid-Calder in 1869, Prof. Gray received his early education at George Watson's College, Edinburgh, and entered the Andersonian College at Glasgow as a student of Prof. Dittmar in 1885. At nineteen years of age, he proceeded to the University of Jena, returning a year later to become assistant to Prof. Dittmar and afterwards to Prof. Henderson. Graduating B.Sc. in the University of London in 1890, his career as a lecturer commenced three years later at the Royal Tech-

nical College and in the same year he was appointed lecturer in chemistry at Queen Margaret College.

The summers of 1899 and 1900 were spent at Jena, where he obtained the degree of Ph.D., and in 1901 he graduated D.Sc., of the University of Glasgow. He also prosecuted his studies at Heidelberg and at the Zurich Polytechnic under Prof. Lunge.

In 1903, on the retirement of Prof. Mills, Dr. Gray succeeded to the 'Young' chair of technical chemistry at the Royal Technical College, and in 1919 was appointed director of the School of Chemistry. He instituted, in the College, the first classes giving public instruction in fuels; and to acquire first-hand knowledge of methods of manufacture and of plant construction, he spent many of his summer vacations in chemical works. During the War period he placed his extensive scientific knowledge at the service of various Government departments, and two outstanding tasks which he undertook were the supervision of the production of benzene and toluene from the Scottish gas works for munition purposes, and an extensive survey of the coals of Scotland with special reference to their suitability for use in blast furnaces and for metallurgical coke manufacture.

The importance of his services during the War and his eminence as a chemist were recognised at the University of Glasgow by the conferment of the honorary degree of LL.D.

In 1918, the Department of Scientific and Industrial Research invited Prof. Gray to supervise the design and organisation of the fuel research laboratories at East Greenwich, and from 1920 he acted as consultant to the Fuel Research Board for three years. At the time of his death he was a member of that Board.

Prof. Gray was a fellow of the Institute of Chemistry and of the Chemical Society, and acted as secretary for ten years and chairman for two years, of the Glasgow Section of the Society of Chemical Industry. Among the committees on which he served, were the Education Committee of the Institution of Gas Engineers, the Scottish Coal Survey Committee, and the Committee on Sampling and Analysis of Coal of the Fuel Research Board, of which he was chairman. His services as an examiner in chemistry were retained by the boards of various institutions, among which were the Faculty of Physicians and Surgeons of Glasgow and the Royal College of Physicians and Surgeons of Edinburgh. He was retained by the British Electric Lamp Manufacturers' Association as a consultant, and his services were much in demand as an expert witness in law cases dealing with chemical patents. Many of his scientific papers were published by the Chemical Society and the Society of Chemical Industry and in the *Berichte*.

In analytical work, Prof. Gray carried accuracy to extremes; and in research his cleverness as a glass blower, and his ingenuity in designing apparatus from the simplest material, were remarkable. An ideal teacher, he was held in high esteem by student and colleague alike. He had a quiet and attractive personality, and to have been included in his circle of friends was to have experienced an ever-increasing admiration for a very fine gentleman. W. J. SKILLING.

M. SALOMON REINACH

BY the death of Salomon Reinach, which took place at Boulogne-sur-Seine on November 4, France has lost one of her most distinguished and widely-known sons, who for more than a generation held a foremost place in the world of scholarship and archæology.

Salomon Reinach was born at St.-Germain on August 29, 1858, and, with his two brothers, also destined to attain high distinction in the world of learning, was educated at the Lycée Condorcet. He afterwards attended the École Normale and took the degrees of doctor of law and doctor of letters at the University of Paris. From that time onward his life was devoted to archæological studies, but in no narrow sense. In his view of the past he saw life whole. The breadth of his knowledge of antiquity was equalled by his understanding of it; and it should be no matter for surprise that he attained a universal reputation as an authority in classical scholarship and the history of philosophy, religion and art as well as in archæology.

In 1879 Reinach at the age of twenty-one years became a member of the French School of Archæology in Athens and later acted as the secretary of the Archæological Commission in Tunis. In 1885 he was appointed to the staff of the National Museums and in the same year published his "Traite d'Epigraphie Grecque", a Latin grammar and a handbook of field archæology. These had already been preceded by a manual of classical philology, issued between 1882 and 1884. By the time he was appointed curator of the Museum of St.-Germain and professor at the Louvre School in 1902, his monumental catalogue of the prehistoric collections of that Museum, which has recently been revised and re-issued, had won for him an established position as an authority in prehistoric archæology. Archæological studies took him to Greece, North Africa, southern Russia, Asia Minor, the whole fringe of the Mediterranean and the Danube. In western Europe his expert knowledge extended from palæolithic man to Gauls and Romans; and his acquaintance with the European museums and their contents was probably unique.

Reinach's literary output in the fields of classical scholarship, philosophy, comparative religion, art and archæology was very large. In 1902 he became the director of the *Révue Archéologique*. Throughout his life a stream of papers, monographs, books and articles came from his pen. It was characteristic of his humanistic attitude that he should also contribute to contemporary history and controversy—in this field he wrote *inter alia* a history

of the War and one of the Russian revolution, while the concluding chapters of the latest edition of his "Orpheus" is a masterly review of post-War tendencies in religious and political thought from his special point of view, that of the philosopher and historian who sees current events broadly, not as an ephemeral manifestation of human activity, but as part of a panoramic whole in which the springs of action are deep-rooted in the principles which govern the growth of humanity and the development of civilisation. He admitted himself something of a disciple of Voltaire, and his "Orpheus", a study of the history of religion in which religions are treated as natural phenomena, aroused some antagonism by his attitude towards Christianity. His writing, in truth, was not always uncoloured by emotion, and it was this, perhaps, which sometimes rendered his judgment open to question, as in his endorsement of the authenticity of the 'antiquities' from Glozel. Yet it is a remarkable tribute to the authority and enduring quality of his work that several of his books ran through more than one edition and of the "Orpheus" there were no less than thirty-eight French editions, the translation of the last appearing in England in 1931.

DR. C. B. MARSON

DR. C. B. MARSON, recently appointed head of the Chemical Department of the Hull Municipal Technical College, died suddenly on October 26.

Dr. Marson was apprenticed to Capt. J. A. Foster, public analyst of Hull, and during most of the War was attached to the French army at Verdun. After that he was on the chemical staff of the British Thomson-Houston Company, Rugby. He resigned that post in order to enter on a course in the Department of Coal Gas and Fuel Industries at the University of Leeds, which was terminated by his taking the B.Sc. degree with first-class honours in fuel and metallurgy, and later the Ph.D. degree. Since that time he has been in succession Gas Research Fellow at the University of Leeds, chemist on the staff of the Joint Research Committee of the Institution of Gas Engineers and the University of Leeds, and chief chemist of the Northern Coke Research Committee, stationed at Armstrong College, Newcastle-on-Tyne, until he took up his post at Hull a few weeks ago.

Dr. Marson was conspicuously successful in every post that he filled, and his untimely death has undoubtedly cut short a promising career.

H. J. H.

WE regret to announce the following deaths:

Dr. Marcus Benjamin, industrial chemist and editor of the publications of the United States National Museum, on October 22, aged seventy-five years.

Sir Dugald Clerk, K.B.E., F.R.S., who was elected president of the Institution of Civil Engineers for this year, but was unable to take office owing to ill-health, and was distinguished by his pioneer work on internal combustion engines, on November 12, aged seventy-eight years.

News and Views

H.R.H. the Duke of York, F.R.S.

HIS ROYAL HIGHNESS THE DUKE OF YORK attended the ordinary meeting of the Royal Society on November 10, signed the roll, and was formally admitted a fellow by the president, Sir Frederick Gowland Hopkins. The Duke had been elected on June 16 last. As is generally known, the opening page in the charter book, denoting the Society's inauguration, bears the signatures "Charles-Founder", "James [Duke of York, afterwards James II.] Fellow", and "Rupert"; the latter was the cousin of the reigning monarch. But another signature—"George", is there, and posterity may well conjecture how his name comes to be subscribed in alignment with that of "Rupert", and not beneath it. There was never a George Rupert; the name was that of George of Denmark, who married the Princess Anne. Elected (or brought into) the Society on its anniversary day, in 1704, and not long after Newton became president, it was the latter who waited on the Prince that day (with others), to obtain his signature, and adherence. Queen Anne herself never signed the charter book.

The Royal Family and the Royal Society

THE election of royal personages, subsequent to the year 1820, whether as patrons (being reigning sovereigns), or, as of blood relationship, is of interest. William IV (elected 1831) signed as patron. Queen Victoria inscribed her name on June 20, 1838, the Prince Consort signing below after election in 1840. King Edward VII signed when Prince of Wales, and again as patron (1901). In the former instance he had been elected in 1863, being proposed by Maj.-Gen. Sabine, the president. It would seem that it was not until March 2, 1882, whilst William Spottiswoode was president, that the Prince attended and inscribed his name. Also, in that year, his brother, the Duke of Edinburgh, was elected. Another brother, the Duke of Connaught, was elected on November 8, 1906, on the proposal of Lord Rayleigh, president, attending for admission in December following. His Royal Highness is, happily, still on the roll. His Majesty King George V was elected a fellow on June 8, 1893, when Duke of York, on the proposal of Lord Kelvin and Sir Michael Foster; on becoming Prince of Wales he then inscribed, and again in 1910 as monarch and patron. More recent times have witnessed the election and admission of Prince Arthur of Connaught (1914), His Royal Highness the Prince of Wales (1919, on the proposal of Sir J. J. Thomson, president); lastly, the Duke of York.

A Nobel Prize for Dr. Irving Langmuir

THE influence of the contributions to modern chemical thought of Dr. Irving Langmuir, who has been awarded the Nobel Prize for chemistry for 1932, is probably more widespread and generally appreciated than those of many of his predecessors. It was as if a new chapter had been commenced in the book of knowledge of the state and behaviour of molecules at interfaces, which forms the very bases of the science of colloids and is of fundamental importance in such diverse ramifications of the physical sciences as heterogeneous catalysis and thermionic emission, when Langmuir published his well-known papers in 1917. As occasionally happens, mathematical treatment may obscure the reality of physical and chemical processes, and that useful tool may prove an obstruction rather than an aid to further advance. It is no exaggeration to say that a new flood of light was thrown on the whole subject of the adsorption of, and reactions of, gases at solid surfaces, as well as the mechanism involved in changes in the surface tension of liquids. There are no better examples of the effects of welding our essentially chemical point of view, in which molecules are regarded as perfectly defined objects of definite form, with a physical appreciation of the general applicability of the Boltzmann distribution law and of the action of local fields of force extending over relatively short distances. This same breadth of treatment is also noted in the more recent and what some may regard as more physical aspects of his work. Thanks to Langmuir, thermionics is now an important branch of physical chemistry.

IT is only natural that investigations of such a fundamental character should have economic consequences, and Langmuir's work has led to many important industrial results, of which the gas-filled lamp is probably most widely appreciated. What was once "Dr. Whitney's experiment" in the General Electric Company has now become the life blood of all important industries, and it is a pity to note that apparently one large European firm is no longer encouraging fundamental research; probably the right men are not available. No small part of Langmuir's contributions to chemistry lies in his enthusiasm and the clarity of his presentation. The Lewis atom became as it were a household word when the concepts were developed, applied and expounded by Langmuir, and one almost had a vision of molecules of fatty acid floating across a water surface when listening to him. Those that know Langmuir as a friend are always impressed both by his kindness and his great breadth of interests. Whether it is ice-skating in winter, observing the formation of ripples and surface currents in summer on Lake George, or noting the brilliance of spiders' eyes when illuminated by a flash-lamp, there is always something of interest, something arresting and something which would convince many a classical scholar of the great advantages of science as an educational medium.

Retirement of Prof. E. B. Poulton, F.R.S.

WHEN, now forty years ago, Prof. E. B. Poulton succeeded Prof. Westwood, its first holder, in the Hope professorship of zoology at Oxford, great anticipations were entertained of the results to follow from the appointment of one who had already distinguished himself as an able investigator and experimenter in the field of evolutionary study. These expectations have been abundantly fulfilled; and it is not too much to say that under Prof. Poulton's untiring exertions, the Hope Department in the University of Oxford has become known throughout the scientific world as a chief centre for the maintenance and development of those views of organic evolution which owe their origin to the epoch-making work of Charles Darwin and Alfred Russel Wallace. Under his energetic administration, the great entomological collection, bequeathed by Mr. Hope and tended in its early days by the first Hope professor, has been immensely increased, and has been made available in an unexampled manner for the illustration of problems of first-rate biological importance. By his influence in stimulating and directing the efforts of observers and collectors in many parts of the world, Prof. Poulton has been able to accumulate a vast amount of material of the highest value for scientific workers at home, to whom he has never failed to afford the utmost help and encouragement. His own labours in the field of bionomics have been far-reaching and fruitful, and have caused him to be known everywhere as the most prominent living upholder of the doctrine of natural selection as propounded by Darwin in the "Origin of Species". His approaching retirement is felt, not only by entomologists, but also by the whole University of Oxford, as a serious loss; and it is much to be hoped that a successor may be found who will recognise and make it his business to carry on the great traditions of the Hope Department. It is a matter of congratulation that Prof. Poulton, when he relinquishes the engrossing task of administration, will be free to continue, on an even larger scale, those researches and expositions which have had so remarkable an influence on the progress of scientific entomology.

Dr. R. A. Millikan

IT is stated by Science Service, of Washington, D.C., that a Roosevelt Medal for achievement in science has been presented to Dr. Robert Andrews Millikan, director of the Norman Bridge Laboratory of Physics and chairman of the executive council of the California Institute of Technology. The presentation was made by James R. Garfield, Secretary of the Interior in the Roosevelt Cabinet. The medal is one of a series of awards established in 1923 by the Roosevelt Memorial Association. Usually three are given each year in three out of twelve fields of activity associated with Col. Roosevelt's career, but only one award has been made in 1932. Dr. Millikan has become widely known because of his achievements in physical research and was awarded the Nobel Prize for physics in 1923. Outstanding among his

accomplishments are the measuring of the charge on the electron and the study of cosmic radiation. Former recipients of the Roosevelt medal for work of a scientific nature include: Prof. Henry Fairfield Osborn, president of the American Museum of Natural History; Dr. Frank M. Chapman, curator of ornithology for the Museum; Dr. Herbert Putnam, librarian of Congress; and Richard E. Byrd, explorer.

Cambridge Philosophical Society

A BRILLIANT company assembled in the hall of Pembroke College, Cambridge, on Saturday, November 12, to celebrate by a dinner the centenary of the grant of a Royal Charter to the Cambridge Philosophical Society. Dr. A. Hutchinson, the Master of the College and president of the Society, was in the chair, and the occasion was honoured by the presence of H.R.H. Prince George. Among other distinguished people present were Mr. Stanley Baldwin, Chancellor of the University, the presidents of the Royal Society and of the British Association, and presidents or directors of many other leading scientific societies and institutions. The toast of the Society was proposed by Prince George and replied to by Dr. Hutchinson. The Master of Trinity proposed the toast of the guests, and responses were made by Mr. Baldwin and Sir William Bragg.

IN his reply to the toast of the Society, Dr. Hutchinson gave an interesting account of its origin and early work, and he was able to show that throughout its existence members of the Royal Family have honoured it by their favour and patronage. H.R.H. the Duke of Gloucester, a nephew of King George III and Chancellor of the University, accepted the office of patron on November 19, 1819, and made a handsome donation to the funds of the Society. Two years later H.R.H. Augustus Frederick, Duke of Sussex and a younger son of King George IV, became a vice-patron of the Society; afterwards he accepted the office of president of the Royal Society. When the Charter was granted by King William IV in 1832 he specifically confirmed his two kinsmen in their offices. The Prince Consort was patron of the Society when he was Chancellor of the University; and Dr. Hutchinson in the course of his speech said that he had been empowered by the Council of the Society to propose that the office of patron be revived, and that the present Chancellor, Mr. Baldwin, be invited to accept it. In his speech later in the evening, Mr. Baldwin stated that he regarded the office as one of high honour and accepted the invitation with pleasure.

Gaseous Combustion at High Pressure

AT the meeting of the Royal Society on November 10 when the Duke of York was admitted to the fellowship of the Society, Prof. W. A. Bone gave an account of Parts 14, 15 and 16 of his researches on gaseous combustion at high pressure. These record an exploration of the phenomena of explosion of hydrogen–air and carbon monoxide–air mixtures into regions of pressure much higher than those hitherto examined and the apparatus specially designed for the purpose was described. Hydrogen–air mixtures explode quite normally with initial pressures up to 500 atmospheres but at 750 atmospheres detonation occurs with violence sufficient to damage the apparatus. Carbon monoxide–air mixtures have been successfully exploded at initial pressures up to 1,000 atmospheres. As previously observed, the nitrogen is activated, absorbing during the early stages energy which is released during the later stages so as to retard the cooling of the products. This activated nitrogen reacts with excess oxygen, if present at the high temperature of explosion, giving oxides of nitrogen, the formation of which is favoured by increase of pressure. Nitric oxide dissociates readily during the process of cooling, so experiments were made in which the cooling is accelerated by causing the gas to expand suddenly at a predetermined instant after firing. Exploding mixtures of $(2CO + 3O_2 + 2N_2)$ at an initial pressure of 70 atmospheres, the yield of nitric oxide is 5·4 per cent, and results at 88 atmospheres indicate a probable maximum of about six per cent. Such yields exceed those previously recorded but are probably insufficient to serve as a basis for the commercial fixation of nitrogen by explosive combustion. Experiments were shown to demonstrate how a rise of pressure increases the luminosity of carbon monoxide–air flames and leads to the formation of oxides of nitrogen.

Heavy Oil Aeroplane Engine

THE Air Ministry has issued some particulars of the first British heavy oil aeroplane engine. The Rolls-Royce 'Condor' compression ignition engine has successfully passed an Air Ministry test of 50 hours, and flight tests are now being undertaken in a Hawker 'Horsley' aeroplane. The engine has been developed from the 'Condor' petrol aeroplane engine, which has been strengthened where necessary to take the increased forces due to the raising of the compression ratio from 6½ to 12½. The maximum explosion pressure within the cylinders is 800 lb. per square inch. At the normal speed of 1,900 revolutions per minute, the engine develops 500 brake horse power. The increase in weight over that of the petrol engine is less than ten per cent, the engine weight being 1,504 lb. or 3 lb. per brake horse power, a weight-power ratio which represents a very large reduction over that of the Beardmore 'Tornado' engines installed in the airship *R 101*. As a petrol engine, the Rolls-Royce 'Condor' has a weight-power ratio of approximately 2 lb. per brake horse power. Assuming that the fuel consumption of the heavy oil engine is twenty-five per cent less than that of the petrol engine, there should be a saving in the total weight of engine and fuel for a lengthy flight such as the present types of aeroplanes are capable of making. In addition, the experimental flight tests are intended to investigate the extent to which the size of the radiator and the weight of cooling water can be reduced as compared with standard petrol engines.

Plant Morphology

MR. H. HAMSHAW THOMAS's paper entitled "The Old Morphology and the New", read before the Linnean Society on November 10, created considerable interest. In recent years, Mr. Thomas said, a great gulf has arisen between the classical concepts of plant morphology and the new ideas which have been suggested by a study of the modern pteridophytes and of the older Palæozoic floras. A century of botanical investigation has not strengthened the foundations of the old morphology, but its modern exponents on the Continent have been led to regard much of what is termed morphology as irrelevant, and they reject all considerations of phylogeny, as well as the studies on the anatomy and cytology of plants. On the other hand, the foundations of the old system have been seriously shaken. Goethe, in a passage which has been generally overlooked, recognised the validity of some of the considerations of the new morphology, the name applied to the concepts put forward by Lignier, Bower, Tansley, and others. According to this view the body of the higher plants is derived from a thallus with forking branches bearing terminal sporangia; large leaves were derived from branch systems which may or may not have continued to bear sporangia. Thus the reproductive structures of the seed plants are to be considered as modified branches or branch systems rather than as modified foliar structures. The application of these ideas to the flowering plants may lead to considerable changes in our ideas of primitive characters. It is suggested that the flowering plants may be derived from the Palæozoic pteridosperms, and this leads to some new suggestions as to the morphology of modern floral structures.

Science and the Community

IN an address to the annual conjoint meeting of the Manchester Chemical Societies on November 10, Prof. A. Findlay, under the title "Science and the Community", strongly deprecated extravagant claims advanced as to the part science has to play in the administration of the State. Much disservice has been done to the cause of science by those who fail to recognise that scientific facts are often only one aspect or factor involved in a problem. Science is only one of the great human values, and attempts to antagonise the spirit of science and the quest of beauty, moral values and ethics are a misfortune to the whole community. Prof. Findlay suggested that, so far as industry is concerned, the battle for the recognition of science is already won, but his opinion that science has already received full recognition in the affairs of State was strongly challenged in the subsequent discussion. Prof. Findlay referred to the excessive specialisation of the average graduate in science and emphasised the need for a wider training and for the imparting of general culture and particularly the sense of values which the philosophy of science inculcates. In this, as in his plea for the recognition of the scientific spirit as one of the great expressions of the human spirit, making a contribution to spiritual welfare of mankind fully as important as that of art and literature and religion, Prof. Findlay presented an admirably balanced picture of the position of science in human culture which was greatly appreciated even by those who most strongly criticised either his assumptions as to the position of science in industry and the State, or the intractability of the human factors in social problems to the probings of the scientific mind.

Mexican Archæological Sites

THE Mexican Supreme Court has ruled, according to a Science Service (Washington, D.C.) message from Mexico City, that the country's archæological sites are under the jurisdiction of the Federal Government, and not that of the individual States. This settles an important issue, as has already been indicated in these columns (NATURE, Oct. 29, p. 656). Upheld by the recent decision, Federal Government archæologists arranged to proceed at once to make excavations at Monte Alban, where the spectacular discovery of a treasure tomb was reported last January. The expedition is under the leadership of Alfonso Caso, the discoverer of the Monte Alban tombs, and he will be assisted by a staff of four archæologists and six students. As little appears to have been known in Great Britain of the case upon which the Supreme Court has now pronounced until the matter was *sub judice*, a brief account of the point at issue and the origin of the dispute between the Federal Government and the States may not be out of place.

HITHERTO the Federal Government alone, with the exception of the State of Mexico, has shown any interest in the protection and investigation of the antiquities of early Mexican civilisation, the State governments being either indifferent, or without the resources necessary for such an undertaking. When, however, the remarkable treasures discovered in the Monte Alban tombs were placed on exhibition in March last, the enormous intrinsic value of the treasure and the wide-spread interest it aroused, which, it may be said, was responsible for the raising of a considerable sum of money from the public in the form of entrance fees, moved the State of Oaxaca, in which Monte Alban is situated, to lay claim to the treasure and to assert its rights over the antiquities within its borders. This at once raised the whole question of Federal and State jurisdiction in relation to antiquities, upon which the Supreme Court has now given its ruling. The decision has been awaited with anxiety, and there can be no doubt that the ruling is in the best interests of the study of Mexican archæology in present circumstances. The individual States have not the experience or the interest in their antiquities requisite for dealing with questions arising out of the granting of concessions for archæological exploration—a matter of importance in view of the widely-extended and invaluable activities of numerous expeditions from the United States now operating in Mexico; they have neither resources, nor personnel

for exploration, nor means for the proper display of archæological finds for scientific study as the Federal Government has; while it is generally thought among Mexican archæologists that, had the decision gone in favour of the States, as was expected, they would not have been able to afford their monuments adequate protection from damage, illicit exploitation and other dangers.

The West Indian Hurricane

THE reports of the hurricane that devastated a large part of Cuba on November 9 after destroying most of the banana crop in Jamaica and causing serious damage and loss of life in Little Cayman and Cayman Brac, show that this was the most destructive of the four storms that have caused much loss of life in the West Indies during the hurricane season that—since it is only once in about ten years that the season extends beyond October—should now be ending. The latest estimates give the loss of life in Cuba alone, due mainly to the sea wave on the south coast raised presumably by the southerly hurricane immediately to the east of the storm centre, as more than two thousand. The death roll was therefore much heavier than for the hurricanes which visited the neighbourhood of Galveston on August 13 last, and the Bahamas on September 5, and even for the very violent hurricane of September 26-27 in Puerto Rico. The most recent storm was abnormal in its track as well as in the late date of its occurrence. From information given in the *Times* of November 11, 12, and 14, it would appear that the centre was moving northwards or a little east of north when it passed to the west of Jamaica, and towards north-east when it crossed Cuba. Many storms pass the neighbourhood of Jamaica or the seas to the south of that island, but they are nearly always moving west or north-west, and, if they recurve to north-east, do so far away and in a much higher latitude. The hurricane season of 1932 will long be remembered, although when the total number of hurricanes in this season can be determined it will probably be found that, in the past fifty years, 1886 and 1887 with eleven storms in each case, still hold first place, while 1916, with a total of eight, remains outstanding in more recent years.

Optical Apparatus at the Science Museum

A SPECIAL exhibition dealing with optical phenomena and optical instruments will be opened at the Science Museum on November 19, and will remain on view until the middle of February, 1933. A special feature of the exhibition will be a number of demonstrations and experiments operable by visitors. These will illustrate reflection, refraction, dispersion, interference, diffraction, and polarisation of light as well as the working of simple optical instruments such as the telescope and microscope. They should be of particular interest to students, especially to those who have not the facilities for performing such experiments themselves. Other demonstrations will include a large projection microscope designed for the examination of metals in large pieces, a rangefinder specially adapted to take short ranges in the Museum, a home cinematograph projector using standard size film, a large ophthalmoscope for examination of the human eye and a modern epidiascope. The historical development of various optical instruments will be illustrated by examples selected from the Museum collections, and current practice in optical instrument manufacture will be further represented by a selection of modern instruments lent by various firms especially for the exhibition.

Exhibition of British Coastal Craft

A TEMPORARY exhibition illustrating the fishing boats and coastal craft of Great Britain will be opened in the Entrance Hall of the Science Museum on November 19 and will remain on view until the middle of February, 1933. Some thirty models which have been selected mainly from the large collection of small craft exhibited in Gallery 61 of the Museum, will be shown, in addition to a collection of about sixty photographic transparencies, some of boats for which no models are available in actual use, and others of detailed plans of the more important types. The arrangement will be geographical and will thus show in their proper relations the yoles and sexerns of the Shetlands and Orkneys, the fifies and baldies of the east coast of Scotland, and the cobbles of Yorkshire, together with the eighteenth century herring-busses and the early nineteenth century three-masted luggers which fished in the North Sea. East Anglia will be represented by the distinctive sailing drifters of Yarmouth, the trawlers of Lowestoft and also by the wherries and older keels of the Broads. There will also be the many craft peculiar to the Thames estuary, the barges, lighters and bawleys, besides the older wherries and peter-boats. From the south coast there will be examples of smacks from Ramsgate and Brixham, the eighteenth century hog-boats of Brighton and the luggers which have succeeded them; also the luggers of Penzance and of Fowey. Very little has yet been written about the west coast local shipping, but several typical examples will be included.

Shyok Glaciers and Indus Floods

UNDER the above title, Mr. J. M. Lacey in an article in the *Engineer* for October 14 gives an account of the formation of the great ice dams which form across the Upper Shyok River in Kashmir, and of the floods in the Indus valley which result from the release of the large volumes of water pent up behind the dams. The Upper Shyok has its source in the Rima Glacier in the Karakoram region, and in its downward course passes the three important glaciers, Chong Kumdan, 9 miles long, falling 3,000 ft.; the Kichik Kumdan, 7 miles long, falling 3,500 ft.; and the Aktash, 5 miles long, falling 2,000 ft. In the event of heavy accumulation of snow on the eastern range, these glaciers advance rapidly into the Shyok gorge. On occasions they flow right across the river until they strike the precipitous cliffs on the opposite side, and sometimes turn down the bed

of the river for hundreds of yards. The first recorded damming of the Shyok occurred in 1779, the water breaking through and causing a flood the following year. Since then the river has been dammed many times but experts find great difficulty in forming any conclusion regarding the periodicity of the advance and retreat of the glaciers. One observer, Major Mason, however, considers that after 1932 there will be no danger of a block for another thirty years.

Medical Uses of Radium

THE Medical Research Council has issued under the above title a summary of reports from research centres for 1931 on the radium treatment of cancer (Special Report Series, No. 174. London: H.M. Stationery Office. 1*s*. 3*d*. net). The main lines of radium therapy employed at present are described, and the results of the treatment of cancer of certain organs—tongue and mouth, breast, uterus, rectum, and others—are detailed. While the immediate results of the treatment are generally beneficial, the ultimate results are disappointing, few cases surviving after three or four years. But it must be remembered that most of the cases are advanced ones and inoperable. For these almost the only hope lies in radium therapy, and occasionally a striking result is obtained. Various methods of applying radium are being tested at the various centres, and we may hope in the future that improved methods will yield better results. A statistical analysis of all the cases treated at the Middlesex Hospital since 1925 is given in an appendix.

New Nature Reserve in Cheshire

AN addition of value has been made to the possessions of the Royal Society for the Protection of Birds in the Eastwood Nature Reserve, Stalybridge (*Bird Notes and News*, Autumn Number). The reserve, originally extending to about eight acres, was bequeathed by the Right Hon. John F. Cheetham, together with £5,000 for its upkeep. To this has been added an adjacent four acres, with £500, by a niece of the donor, Mrs. Wimbush of Taunton. The reserve is a beautiful ravine within the public park given by Mr. Cheetham to Stalybridge, and his wish that it should be kept in a natural state as regards fauna and flora will insure the continuance of a sample of wild Nature in the heart of an industrial area. Already there is abundance of wild plants and unexpected variety of birds, and judicious treatment of the reserve should add to the attractiveness of both.

Announcements

SIR ARTHUR KEITH, who is recovering from a serious illness, has been given six months' leave of absence by the Council of the Royal College of Surgeons of England. During his absence, the duties of conservator of the Museum of the College will be taken over by Mr. R. H. Burne, physiological curator to the Museum.

THE New Tank of the William Froude Laboratory at the National Physical Laboratory will be opened by the Right Hon. Stanley Baldwin on November 18 at three o'clock. Several demonstrations will be given at the opening ceremony, including screw propeller tests in the New Tank and rough water experiments in the Alfred Yarrow Tank.

A COURSE of lectures on "The Fear of Death in Primitive Religion" will be delivered by Sir James Frazer at University College, Gower Street, London, W.C.1, on November 25, November 29 and December 1, at 5 P.M. The lectures, although addressed to students of the University, will be open to others interested in the subject. Admission will be free and without ticket.

PROF. M. ISHIMOTO has been appointed director of the Earthquake Research Institute, Tokyo, in succession to Prof. K. Suyehiro, who died on April 9 of this year (see NATURE, 130, 132, 1932). Prof. Ishimoto is well known as the inventor of a tiltmeter, resembling Zöllner's horizontal pendulum, with which he has made many interesting observations on the tilts of the ground immediately preceding earthquakes.

AT the anniversary meeting of the Mineralogical Society held on November 1 the following officers were elected:—*President:* Sir John Flett; *Vice-Presidents:* Prof. C. Gilbert Cullis, Mr. Arthur Russell; *Treasurer:* Mr. F. N. Ashcroft; *General Secretary:* Mr. W. Campbell Smith; *Foreign Secretary:* Prof. A. Hutchinson; *Editor of the Journal:* Dr. L. J. Spencer.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in mathematics, mechanics and physics at the Polytechnic, Regent Street, London, W.1.—The Director of Education (Nov. 21). A joint examiner in mathematics for the Higher School Certificate Examination of the University of Bristol—The Registrar (Nov. 30). Two assistant civil engineers for the Directorate of Works, The War Office—The Under-Secretary of State (C.5.), The War Office, London, S.W.1 (Nov. 23). A public analyst to the Metropolitan Borough of Woolwich—The Town Clerk, Town Hall, Woolwich, S.E.18 (Dec. 2). A waterfowl research assistant at the National Institute of Poultry Husbandry—The Director, National Institute of Poultry Husbandry, Newport, Salop (Dec. 5). A laboratory steward in the Department of Zoology of the University of Bristol—The Registrar (Dec. 6). A secretary, assistant librarian and assistant curator of the Manx Museum—The Curator, Manx Museum, Douglas, Isle of Man (Dec. 7). A research fellow in bacteriology at the Lister Institute of Preventive Medicine—The Secretary, Lister Institute, Chelsea Bridge Road, London, S.W.1 (Dec. 9). An independent lecturer in applied mathematics at the University College of Wales, Aberystwyth—The Secretary (Feb. 1).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Ultra-Violet Absorption Spectrum and Chemical Structure of Vitamin B_1

WE have been particularly interested in the report in NATURE[1] by Bowden and Snow regarding the photochemistry of the vitamins, in view of our investigations of the absorption spectra of various vitamin B_1 concentrates, a preliminary report of which was presented at the meeting of the American Chemical Society at Buffalo, September, 1931.[2] At that time we noted that the concentrates examined had absorption maxima at 2600 A., but as the concentrates were admittedly impure, and as some also presented maxima at other wave-lengths, we hesitated to identify any band with vitamin B_1.

In view of the possible presence of contaminating substances in the Jansen-Donath preparation used by Bowden and Snow, we agree with Morton and Heilbron[3] that their definite conclusion, "The correlation of the 2600 band with the activity of vitamin B_1 has thus been fully established" seems scarcely to have been justified by their reported experiment, in which irradiation of the preparation with the 2560 A. line reduced the intensity of the 2600 A. absorption band and destroyed the B_1 activity. Particularly is this true because, as we pointed out in our previous paper, certain biologically inactive purines and pyrimidines (which we have shown to be characterised by an absorption maximum at 2600 A., and to be destroyed by certain regions of the ultra-violet[4]), might be expected to contaminate B_1 concentrates. In view of this difficulty, we believed it advisable, at the time of our earlier report, to carry out parallel spectrographic and biological studies on a number of B_1 preparations before making positive statements about the absorption of the vitamin.

During the course of our later investigations, and prior to the publication of Bowden and Snow's report, Windaus and his co-workers[5] announced a crystalline B_1 preparation, believed by them to be pure B_1, which had, indeed, a pronounced absorption maximum at 2600 A.

Our later experiments include the comparison of the biological activity and ultra-violet absorption spectra of four B_1 concentrates prepared in this Laboratory, of three kindly supplied us by other workers, and of three reported by Guha[6] and by Windaus[5]. Full details of the spectrographic technique and biological assays will appear shortly in the *Bulletin of Basic Science Research*. The absorption curves of all these are presented in Fig. 1. The biological activity of three of these preparations (H_4, and the two Guha preparations) have not been determined by methods permitting comparison of their activities with those of the others.

In agreement with our previous suggestions, it was found that the two relatively inactive concentrates (H_1 and Cerecedo) had very high absorption in the 2600 A. region, presumably because of the presence of inactive purines or pyrimidines. When these were eliminated, a good degree of correlation was found between the activity and the absorption at 2600 A., better than that at any other wave-length in the ultra-violet spectrum. If, for example, the activity and the extinction at 2600 A. of the Windaus preparation are each taken as 100, these values are respectively, for the other four concentrates: Heyroth II, 26·7, 29·8; Seidell (30:85), 24·0, 32·8; Heyroth III, 6·7, 7·0; Seidell (30:182), 4·8, 14·4. This, together with the fact that a maximum at or near 2600 A. was found in all of the concentrates, indicated that vitamin B_1 is characterised by a 2600 A. band.

The type of absorption thus attributed to vitamin B_1 resembles most closely, of the nitrogenous heterocyclic compounds which have thus far been investigated, the absorption of pyrimidine-ring-containing compounds, or of compounds of the type of ergothioneine. The absorption curve of the sulphur-containing Windaus preparation, the most active of

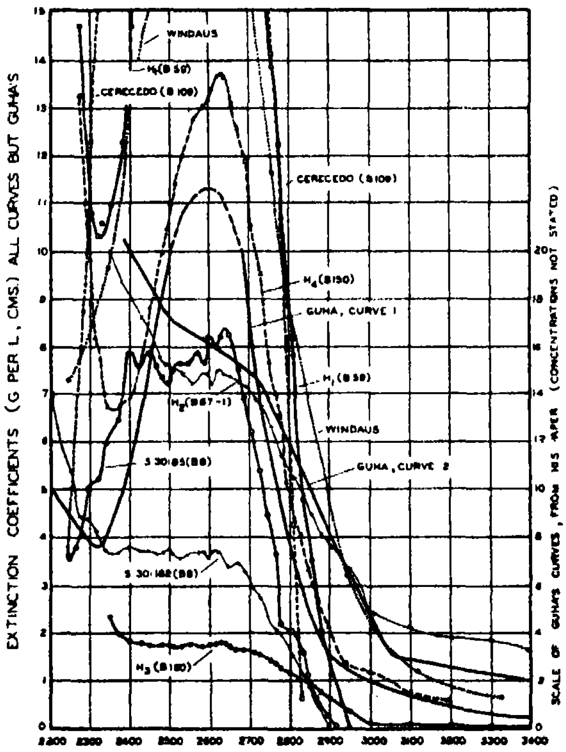

FIG. 1.—Ultra-violet absorption spectra of various vitamin B_1 concentrates.

those considered, is in fact very similar to that of uracil[4] or other pyrimidines. The molecular extinction coefficient of the Windaus preparation at 2600 A. as calculated from the empirical formula of Windaus is 8225, and as calculated from the formula of van Veen[7] is 8925. That of uracil at the same wave-length is 9500.[4]

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JOHN R. LOOFBOUROW.
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University of Cincinnati,
Cincinnati, Ohio.
Aug. 24.

[1] NATURE, 129, 720; 1932.
[2] Heyroth and Loofbourow, *Bull. Bas. Sci. Res.*, 3, 237; 1931.
[3] NATURE, 129, 866; 1932.
[4] Heyroth and Loofbourow, *J. Amer. Chem. Soc.*, 53, 3441; 1931.
[5] Windaus, Tschesche, Ruhkopf, Laquer, and Schultz, *Z. physiol. Chem.*, 204, 123; 1932.
[6] Guha, *Biochem. J.*, 25, 941; 1931.
[7] van Veen, *Rec. trav. Chim.*, 50, 200, 208, 610; 1931.

THE experiments of Heyroth and Loofbourow have established a close correlation between the physiological activity of concentrates of vitamin B_1 (after eliminating inactive purines and pyrimidines, which absorb in the same spectral region), and the intensity of the absorption band at 2600 A. They have thus provided a welcome confirmation of the proof which we gave in our letter to NATURE of May 14, that vitamin B_1 is characterised by an absorption covering the mercury line at 2537 A. The detection in their concentrates of inactive substances which absorb light of similar wave-length is of great value as a guide to the conditions under which the intensity of the band may be used as a measure of the concentration of the vitamin; but the identification of the characteristic band by the method of monochromatic irradiation was independent of the presence or absence of these impurities in the apparently homogeneous crystals which were used in our experiments.

In general, a molecule cannot be destroyed by light which it does not absorb. The only exception to this rule is provided by the phenomenon of photosensitisation. Thus, if light is absorbed by alien molecules of type A, giving rise to chemically active products, such as atoms of chlorine, it may happen that molecules of type B can be destroyed indirectly by the secondary chemical changes which these products are able to effect. This phenomenon, however, depends on a series of contingencies which we regard as unlikely, especially with so stable a vitamin. Moreover, an additional coincidence would be required to account for the parallel effects produced by irradiation and by the action of alkali, as described below.

If this indirect mechanism is excluded, the destruction of physiological activity which resulted from irradiation with the mercury line 2537 A. proves that light of this wave-length is absorbed selectively by the vitamin and that the absorption band at this wave-length is photochemically active.

The correlation of this band with the biological activity of the vitamin was confirmed by experiments in which both were destroyed by the action of alkali; but this action is less specific than that of monochromatic light, and was therefore cited only as collateral evidence in support of the more rigid proof which was made possible by the method of monochromatic irradiation.

F. P. BOWDEN.
C. P. SNOW.
Laboratory of Physical Chemistry,
Cambridge. Oct. 29.

Potency of Vitamin B_1 Preparations

RECENTLY (1932),[1] we have advanced indirect evidence for the belief that crystalline specimens of vitamin B_1 from baker's yeast, prepared by our methods, were more potent than those of Windaus, Tschesche *et al.* (1932).[2] Owing to their courtesy, we have been able to confirm this by direct test. Comparative tests upon pigeons (by curative method) have been made. As birds developed characteristic symptoms, they have been given alternately by mouth, approximately 14γ (0·014 mgm.) of each preparation. (Results by mouth are usually 30 per cent. lower than by injection.) The results were as follows:

Prep.	No. of birds	Dose given.	Average day dose	Standard error of mean	Vitamin B_1 units/mgm.*
G. (Windaus,					
Tschesche	10	14·2γ	4·81γ	0·63	279
et al.)	8	23·28γ	4·58γ	0·41	262
E. (our own)	10	13·8γ	2·56γ	0·35	469

The mean difference in potency $G:E$ is $1:1{\cdot}75$; that is, ours proved to be one and three quarter times as potent. Tested by the usual statistical formula, this difference would occur by chance less than once in fifty trials. It is supported by the tests upon larger doses, and also by reckoning the percentage cures with 14γ dose. For G we have 10/13 cured, and for E 10/10. As we have found it possible to fractionate our crystals still further, we have no hesitation in concluding that more potent vitamin B_1 can be prepared than preparation G, and that this cannot be therefore pure vitamin B_1.

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RUDOLPH A. PETERS.
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* 12 mgm. Janson acid clay ~ 1 pigeon dose.
[1] *J. Physiol.*, **76**, 1; 1932.
[2] Windaus, Tschesche, Ruhkopf, Laquer and Schultz, *Z. physiol. Chem.*, **204**, 123; 1932.

A Growth-Stimulating Substance in Fatigued Muscle

MUSCULAR exercise results in development of the muscles concerned, and it influences other parts of the body. A metabolic product of muscular activity is probably responsible for the muscle hypertrophy, and it is possible that such a hormone may circulate in the blood and stimulate other organs. To our knowledge the only experimental study of this question is that of Bělehrádek[1], who fed tadpoles with artificially fatigued frog muscle. The weight of these tadpoles was increased by 28 per cent compared with controls fed on resting frog muscle, and they metamorphosed earlier than the controls. This has been confirmed by Siebert and Petow.[2]

We have extended this work by feeding blow-fly larvæ with frog muscle fatigued by electrical stimulation through the nerve. In 16 out of 18 experiments the larvæ fed on fatigued muscle grew larger than those fed on resting muscle, the average excess weight being 9 per cent. The larvæ fed on fatigued muscle did not metamorphose earlier than the controls, and their oxygen consumption was unchanged; but the rate of heart beat of the former exceeded that of the latter by 14 per cent.

Work is now being continued on the substances responsible for this growth stimulation and on their mode of action.

H. MUNRO FOX.
G. PUGH SMITH.
Zoological Department,
University of Birmingham.
Oct. 27.

[1] *Arch. Int. Physiol.*, **22**, 376; 1924.
[2] *Z. klin. Med.*, **102**, 434; 1925.

Limiting Mobilities of Some Monovalent Ions and the Dissociation Constant of Acetic Acid at 25°

VOGEL and Jeffery in a recent letter,[1] with the same heading as the above, have directed attention to the fact that we omitted, in our recent paper,[2] to mention that they have published[3] different figures from ours for the limiting mobilities of ions. Though we should, possibly, have referred to their work in that particular connexion, it was not ignored. The conductance measurements of these authors and the

discrepancies between their work and ours were discussed in a paper from this Laboratory.[4] This paper directs attention to the fact that Jeffery and Vogel used a bridge and cells which, due to parasitic currents, could readily give errors in the results. Their use of a water thermostat leads to additional errors of similar nature, as has been shown by Jones and Josephs.[5] Jeffery and Vogel have published conductance measurements only. To obtain ion conductances transference data are necessary. In their paper they present *two* sets of figures for the limiting ion conductances, leaving the choice to the reader. One set is based on a limiting transference number of potassium in potassium chloride of 0·497 and the other on a value of that constant of 0·490, the latter being the result of recent work in our Laboratory.

As to our results, the limiting conductance of the chloride ion, λ_{0Cl}, from which all the other limiting ion conductances may be computed, is based on measurements of conductance, *and transference numbers*, at a series of concentrations of four different chlorides (KCl, NaCl, LiCl, and HCl), and the same result $\lambda_{0Cl} = 76{\cdot}32$, within a few hundredths of a per cent is obtained from the data on each electrolyte. Previous workers have assumed validity of Kohlrausch's law of independent ion mobilities. We feel that our work has proved it, at least for these chlorides.

Our extrapolations have been made using a method based on the assumption that as the dilution is increased ion conductances will approach the relations derived by Onsager.[6]

Vogel and Jeffery also report an ionisation constant of $1{\cdot}776 \times 10^{-5}$ for acetic acid which, they point out, differs considerably from that published by MacInnes and Shedlovsky[7] who give $1{\cdot}753 \times 10^{-5}$ for that constant. We feel that it is sufficient to direct attention to the recent result of Harned and Ehlers[8] who, as the result of an extensive and careful investigation involving galvanic cells without liquid junctions, obtained the value $1{\cdot}754 \times 10^{-5}$ This check is particularly gratifying, since the methods used in the two researches are quite different.

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THEODORE SHEDLOVSKY.
LEWIS G. LONGSWORTH.

The Rockefeller Institute
for Medical Research,
New York, N.Y.,
Sept. 28.

[1] NATURE, 130, 435; 1932.
[2] J. Amer. Chem. Soc., 54, 2758; 1932.
[3] J. Chem. Soc., 1715; 1931. 400; 1932.
[4] J. Amer. Chem. Soc., 54, 1411; 1932.
[5] J. Amer. Chem. Soc., 50, 1065; 1928.
[6] Physik. Z., 27, 388; 1926. 28, 277; 1927.
[7] J. Amer. Chem. Soc., 54, 1429; 1932.
[8] J. Amer. Chem. Soc., 54, 1350; 1932.

Emission of Positive Ions from Cold Surfaces under the Influence of Strong Electric Fields

BEAMS[1] has brought forward experimental evidence showing that the application of a field of the order of 5×10^6 volts per cm. to a tungsten surface may result in the direct removal of adsorbed positive ions of the alkali metals. Ianitsky[2] had previously described experiments in which such an effect was obtained with fields about a hundred times smaller, the positive ions concerned being those of the permanent gases.

I have recently been led to investigate the fluorescence of the glass in a hot cathode X-ray tube,[3] and found that the most negative part of the glass occasionally showed fluorescent spots, which must therefore have been due to positive ion bombardment. The phenomenon was observed with the filament switched off, the gas pressure less than 2×10^{-6} mm. of Hg, and only 20 k.v. across the tube. A detailed consideration of possible mechanisms of formation of the positive ions eliminated all but one, namely, their removal from an adsorbed layer of impurity on the anode. This confirms the observations of Ianitsky, who however did not observe the positive ions as such but by the resulting change in gas pressure.

Ianitsky suggested that the adsorbed gas layer normally exists in a partially ionised form, so that the phenomenon observed by him and by myself would be fundamentally the same as that observed by Beams. It seems to me more probable, however, that it was fundamentally different, the gas layer being *first* ionised by X-rays or by electrons (which would have inevitably been present in the experiments), and *then* the ions removed by the field. Since some of the ions would be formed at a distance of several atomic radii from the surface, a much smaller field would suffice for their removal than was required in Beams's experiments with degassed surfaces. This agrees with experiment.

It seems, however, likely that the compound effect was present in the experiments Beams carried out on gas layers. If this was so, the observed critical voltage for the effect to occur was either that for the positive ion emission or that for starting the discharge responsible for the ionisation, whichever was the larger of the two.

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University of Bristol.

[1] Phys. Rev., 41, 687; 1932.
[2] J. Phys., 1, 153; 1930.
[3] Described in the October issue of the Proc. Camb. Phil. Soc.; 1932.

Origin of Zero-Point Entropy

EUCKEN and his collaborators have pointed out that the failure of Nernst's heat theorem—the so-called third law of thermodynamics—which occurs in some cases, is due to the zero-point entropy[1]. A definite zero-point entropy arises from the existence of 'frozen-in' phases stable at higher temperatures which do not reach the real thermal equilibrium on cooling to the neighbourhood of the absolute zero. Teske and I, for example, have found that solid carbon monoxide near 10°K. exhibits such a state in spite of its crystalline structure[2]. Clayton and Giauque have confirmed this result[3] and explained the discrepancy by the suggestion that the asymmetry of the carbon monoxide molecule gives rise to two positions in the lattice of nearly equal energy. The formation of a fully ordered crystal is thus prevented. No such effect is to be expected in the case of nitrogen, which is a symmetrical molecule. Dr. Teller has directed my attention to the fact that similar behaviour may be shown by nitrous oxide as opposed to the symmetrical carbon dioxide: this has proved to be true.

The following table gives some zero-point entropies calculated from the difference of the direct thermal measurements and the entropy value from band spectroscopic data. If the disarrangement is

complete, the basic probability is 2 instead of 1 as in a perfect crystal and the resulting entropy would be

$$R \ln 2 = 1 \cdot 38 \text{ units as maximum.}$$

Molecule	Zero-point entropy	Author
$N = N$	$-0 \cdot 07 \pm 0 \cdot 20 \sim 0$	Eucken, 1929.[1]
$O = C = O$	$+0 \cdot 32 \pm 0 \cdot 27 \sim 0$	Eucken, 1929.[1]
$C = O$	$+1 \cdot 06 \pm 0 \cdot 25$	Clusius and Teske, 1929.[2]
	$+1 \cdot 12 \pm 0 \cdot 10$	Clayton and Giauque.[3]
$N = N = O$	$+0 \cdot 90 \pm 0 \cdot 32$	Clusius, Vaughen and Hiller, 1930.[4]
$N = O$	$+0 \cdot 75 \pm 0 \cdot 10$	Johnston and Giauque, 1929.[5]

The values of Giauque and his collaborators are explicitly given by these authors. The other data are calculated from the difference of the vapour pressure constant and the chemical constant. The latter has been found by using the value $59 \cdot 4 \times 10^{-40}$ C.G.S. units for the momentum of inertia for nitrous oxide and $70 \cdot 8 \times 10^{-40}$ C.G.S. units for the same quantity for carbon dioxide.[6]

The symmetrical molecules nitrogen and carbon dioxide show no appreciable effect, while the asymmetric carbon monoxide, nitrous oxide and nitric oxide show a definite discrepancy of the same sign, order of magnitude and presumably the same origin.

In conclusion, Nernst's theorem does not apply to structures composed of asymmetric molecules held in position in the lattice by relatively weak orientational forces. We intend to investigate in this laboratory other asymmetric molecules and the possibility of more complete arrangement at liquid helium temperatures. Otherwise it is to be expected that the residual entropy will diminish with increasing molecular asymmetry.

K. CLUSIUS.

Göttingen.
Sept. 28.

[1] Eucken and Fried, *Z. Phys.*, **29**, 36; 1924. Eucken, *Phys. Z.*, **30**, 818; 1929. **31**, 361; 1930.
[2] Clusius and Teske, *Z. phys. Chem.* (B), **6**, 135; 1929.
[3] Clayton and Giauque, *J. Amer. Chem. Soc.*, **54**, 2610; 1932.
[4] Clusius, Hiller and Vaughen, *Z. phys. Chem.*, (B), **8**, 427; 1930.
[5] Johnston and Giauque, *J. Amer. Chem. Soc.*, **51**, 3194; 1929.
[6] Plyler and Barker, *Phys. Rev.*, **38**, 1825; 1931. Martin and Barker, *Phys. Rev.*, **41**, 291; 1932.

Eddington's Theory and Physical Constants

EDDINGTON'S[1] equation for the mass of proton or electron

$$10m^2 - 136m + 1 = 0 \quad (1)$$

holds only for 'very mild' interaction between the elementary charges. It has been extended for interactions at intra-atomic distances and the equation comes out to be

$$10m^2 - 135m + 1 = 0 \quad (2)$$

The 'free' mass from (1) and 'singly constrained' mass from (2) give two values of e/m in perfect agreement with the deflection and the spectroscopic values respectively. For intra-atomic problems the latter alone is applicable. By using Eddington's[1] relation $ch/2\pi e^2 = 137$ and the precise values for the Rydberg number for hydrogen (H_1) [2], Faraday's constant[2], the velocity of light[2] and the chemical atomic weight of monoprotonic hydrogen, from Bleakney's $H_1 : H_2$ ratio[2,3] the following precision values are obtained.

Chemical atomic weight of monoprotonic hydrogen .	$H_1 = 1 \cdot 00774$	$\pm 0 \cdot 00002$
Rydberg number for infinite mass	$R = 109737 \cdot 516$	$\pm 0 \cdot 050$
Specific charge of free electrons	$e/m_0 = 1 \cdot 77001$	$\pm 0 \cdot 00013 \times 10^7$ e.m.u.
Specific charge of singly-bound electrons . . .	$e/m_1 = 1 \cdot 75697$	$\pm 0 \cdot 00013 \times 10^7$ e.m.u.
Electronic charge . . .	$e = 4 \cdot 81209$	$\pm 0 \cdot 00037 \times 10^{-10}$ e.s.u.
Avogadro's number . . .	$N = 6 \cdot 01132$	$\pm 0 \cdot 00089 \times 10^{23}$
Planck's constant . . .	$h = 6 \cdot 64879$	$\pm 0 \cdot 00102 \times 10^{-27}$
Compton shift for free electrons at 90° . . .	$h/m_0c = 0 \cdot 0244557$	$\pm 0 \cdot 0000003 \times 10^{-8}$ cm.
Compton shift for singly-bound electrons at 90°	$h/m_1c = 0 \cdot 0242758$	$\pm 0 \cdot 0000003 \times 10^{-8}$ cm.
Wave-length of molybdenum $K\alpha_1$, line	$= 0 \cdot 709701$	$\pm 0 \cdot 000016 \times 10^{-8}$ cm.
Calcite grating space (Yuching Tu's crystal) .	$= 3 \cdot 03749$	$\pm 0 \cdot 00048 \times 10^{-8}$ cm.
Wien's radiation constant .	$hc/k = 1 \cdot 44128$	$\pm 0 \cdot 00013$
Stefan's radiation constant .	$= 5 \cdot 65050$	$\pm 0 \cdot 00051 \times 10^{-5}$

Perry and Chaffee's[4] and Kirchner's[5] determinations of e/m have been analysed. Systematic errors in the method, procedure and apparatus have been found which account for a correction of more than $+0 \cdot 8$ per cent. So far as the corrections are determinable, calculations from both the data give the value $1 \cdot 770 \times 10^7$ in agreement with the e/m_0 value given above and not $1 \cdot 760 \times 10^7$.

Millikan's[6] value for e has been analysed and found to require a correction, due to the holes in the top plate of his condenser, amounting nearly to $+0 \cdot 8$ per cent. The values got by direct measurement of charge on α-rays by Braddick and Cave[7] and Ward, Wynne Williams and Cave[8] give a value in agreement with the above. Also the discrepancy between grating and crystal values of X-ray wavelengths has been removed by the above, without calling into account the hypothetical mosaic structure suggested by Zwicky[9] against which there is already so much evidence, at least in the X-ray measurements.

The criticisms of Birge[2,10] against $ch/2\pi e^2 = 137$ have been analysed and found to disappear completely on using the corrected values of e and e/m'.

A detailed discussion will be published early.

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Oct. 5.

[1] Eddington, *Proc. Roy. Soc.*, A, **134**, 524; 1932.
[2] Birge, *Phys. Rev.*, Supplement 1, 1; 1929.
[3] Bleakney, *Phys. Rev.*, **41**, 32; 1932.
[4] Perry and Chaffee, *Phys. Rev.*, **36**, 904; 1930.
[5] Kirchner, *Ann. Physik*, **8**, 975; 1931.
[6] Millikan, *Phil. Mag.*, **34**, 1; 1917.
[7] Braddick and Cave, *Proc. Roy. Soc.*, A, **121**, 367; 1928.
[8] Ward, Wynne Williams and Cave, *Proc. Roy. Soc.*, A, **125**, 713; 1929.
[9] Zwicky, *Proc. Nat. Acad. Sci.*, **16**, 211; 1930.
[10] Birge, *Phys. Rev.*, **40**, 228; 1932.

Occurrence of *Lithothamnion* in the South Indian Cretaceous

IN two previous communications[1] one of us reported the discovery of abundant algæ, chiefly *Lithothamnion*, in some of the limestones of Upper Cretaceous age from the Trichinopoly and Pondicherry areas of South India.

In the course of a recent examination of the limestone ridges near Cullygoody (Trichinopoly Cretaceous area) we have collected a number of specimens of a pebbly or conglomeratic rock, which is often found at the base of these limestones. In hand specimens, this rock shows a number of rounded or oval cream-coloured 'pebbles' and presents an appearance very similar to the pebbly character of some of the Niniyur flints and cherts.[2] A micro-

scopic examination of this pebbly rock has also revealed the occurrence of abundant *Lithothamnion* of which at least three different kinds seem to be recognisable—all the 'pebbles' being seen as nothing but patches of algæ.

We consider the occurrence of these algæ in the Cullygoody limestone as of great importance since they belong to a period even earlier than that represented by the Niniyur flints and limestones. Whereas the latter represent the topmost sub-division of the Trichinopoly Cretaceous, corresponding to the Danian of the European stratigraphical scale, the Cullygoody limestone is a member of the lowermost sub-division—the Utatur stage—which is equivalent to the European Cenomanian.

From the evidence now available it is thus obvious that not only were the algæ abundantly present during the Cretaceous period in India, but also that they have been one of the most important limestone builders in the upper Cretaceous seas of Southern India.

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[1] NATURE, Aug. 8, 1931, p. 225, and Nov. 21, 1931, p. 873.
[2] NATURE, Mar. 19, 1932, p. 441.

Diploidisation of Haploid by Diploid Mycelium of *Puccinia helianthi* Schw.

THE interaction of two haploid cells of opposite sex to produce the diplophase is a phenomenon well known in heterothallic species of the Hymenomycetes and of the smut and rust fungi. Buller[1] has recently shown that a diploid mycelium of *Coprinus lagopus*, on coming into contact with a haploid mycelium of that species, transforms the latter mycelium into the diploid condition. He has introduced the word *diploidisation* "to designate in the Hymenomycetes the process by which a haploid cell, or mycelium, is converted into a diploid cell, or mycelium, by the formation of conjugate nuclei within the cell or mycelium". An extension of the application of this term to designate a similar process in other groups of the Basidiomycetes, such as the smuts and rusts, does not appear inappropriate.

Craigie[2] found that *Puccinia helianthi* Schw. is heterothallic. His experiments showed that the diploid, or æcial, stage could be produced by allowing two haploid pustules of opposite sex to coalesce, or by applying the pycnospore-containing nectar of a haploid pustule of one sex to a similar pustule of opposite sex. Experiments which I have recently carried out show that diploidisation of a haploid mycelium of this rust also occurs when it comes into contact with a diploid mycelium. This phenomenon may very probably be found to occur in other heterothallic eu-autoecious rusts.

Sporidia of *P. helianthi* were sown sparsely on the upper surface of the first two foliage leaves of sunflower seedlings (*Helianthus annuus* L.). From these inoculations there arose forty-nine haploid pustules.

When three weeks old, none of these pustules bore æcia. Twelve of them were then marked, to serve as controls; and beside sixteen others, at a point just beyond the periphery of each, urediniospores of *P. helianthi* were sown. A week later urediniospores were sown similarly beside twelve other pustules; and, a week later still, a sowing of urediniospores was made beside the remaining pustules.

As a result of these inoculations, uredinia (diploid pustules) arose at, or very near to, the margin of each of the thirty-seven haploid pustules. Thus diploid mycelium grew in juxtaposition to haploid mycelium.

From eight to twelve days after the inoculations with urediniospores were made, æcia began to appear on the under side of all the thirty-seven pustules. Usually the æcia first appeared in that part of a pustule lying nearest to the uredinial pustules, and later in the parts more remote (Fig. 1). In a few pustules, the first æcia to appear arose rather irregularly spaced over the whole under-surface of each. No æcia appeared in any of the control pustules.

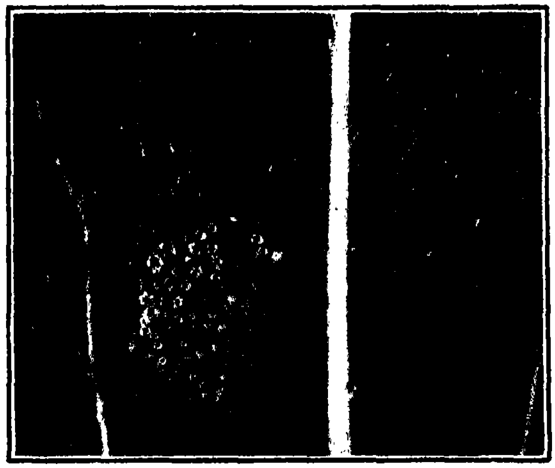

FIG. 1.—The under surface of a part of a sunflower leaf showing a monosporidial (haploid) pustule of *Puccinia helianthi* in which has occurred diploidisation by uredinial (diploid) pustules of that rust. Æcia have appeared at the side of the monosporidial pustule adjoining the uredinial pustules. The photograph was taken fourteen days after the leaf was inoculated with urediniospores, at which time the monosporidial pustule was thirty days old. × 4·5.

A cytological examination of the pustules which produced æcia has not been made, but it is assumed on the basis of these experiments that, when contact between a haploid and a diploid mycelium of *P. helianthi* is established, the diploidisation of the haploid mycelium is effected by successive nuclear divisions and migrations, as has been described by Buller[1] for *C. lagopus*.

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Sept. 16.

[1] Buller, A. H. R., NATURE, 126, 686, Nov. 1, 1930; "Researches on Fungi", vol. 4, p. 187; 1931.
[2] Craigie, J. H., NATURE, 120, 116 and 765, July 23 and Nov. 26, 1927.

Helium Content of Beryllium

THE abnormally high helium content of several Palæozoic beryls discovered by Strutt[1] has recently been verified by Paneth and Guenther.[2] Atkinson and Houttermans have discussed[3] the proton bombardment in the interior of the stars and the possible formation of Be^8 which being probably unstable would yield two helium nuclei, and Lord Rayleigh[4] suggests that the

high helium content of beryls might conceivably be due to Be^8 which has existed in geological times even if not known to exist at present. This implies, however, that Be^8 existed at least in Palæozoic times, a relatively very late period since the star state and proton bombardment. The recent experiments of Cockcroft and Walton[5] would indicate that Be^8 can have only a very short life period. A possible source of excess helium might be found, however, in the following proposed mechanism:

$$Be^9 + \alpha\text{-particle} = 3 \text{ He nuclei} + \text{neutron},$$

and treating this in a similar manner to Chadwick's treatment,[6] the maximum energy of the emission of the neutron is about $5 \cdot 2 \times 10^6$ electron volts as compared to $5 \cdot 7 \times 10^6$ found in Chadwick's experiments and a maximum energy of about 8×10^6 electron volts given by the equation assuming C^{12} is the end product. If both mechanisms are possible we might then expect two groups of neutrons of different maximum energies. In the Palæozoic beryl, about 300×10^6 years old, radium was detected but no thorium. The α-particle of greatest kinetic energy is therefore from Ra C′ which would give a maximum energy to the neutron of about $7 \cdot 7 \times 10^6$ volts or about $10 \cdot 5 \times 10^6$ if C^{12} is the end product.

Even if every α-particle is effective, however, a maximum of only three times the helium produced by the radioactive integration can be expected. The contribution to the helium which is to be expected from the work of N. Feather,[7] in which it is shown possible to free an α-particle by neutron bombardment of nitrogen or possibly some other element, contained in the mineral, can only be a small fraction of the radioactive helium, since only one neutron is formed from each effective α-particle and but a small fraction of these cause disintegration. Moreover, the sequence of events by which a neutron ejects a proton in the mass of the beryl and this in turn builds Be^8 which breaks down into two α-particles is so unlikely as not to come into consideration at all in accounting for the excess helium.

All the above possible mechanisms are, therefore, insufficient to account for the excess helium in the beryls such as from Chester, Penn., U.S.A., containing $0 \cdot 19 \times 10^{-2}$ gm. uranium which would generate approximately $0 \cdot 065$ c.c. of helium in 300×10^6 years, a reasonable lapse of time since the Palæozoic age, compared to the experimentally determined value of at least $0 \cdot 68$ c.c.

Nevertheless, such possible sources of extraneous helium must be considered when determining geological age by the helium ratio, especially when the lighter elements are in abundance.

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Oct. 8.

[1] *Proc. Roy. Soc.*, A, **80**, 572; 1908. A, **84**, 104; 1910.
[2] *Z. Phys. Chemie*, B., **112**, 170; 1928.
[3] NATURE, **123**, 567; 1929.
[4] NATURE, **123**, 607; 1929.
[5] *Proc. Roy. Soc.*, A, **136**, 743; 1932.
[6] *Proc. Roy. Soc.*, A, **136**, 699; 1932.
[7] *Proc. Roy. Soc.*, A, **136**, 709; 1932.

Natural Melody

IN his letter in NATURE of November 5 on "Natural Melody" Sir Richard Paget inquires whether such an effect can have been produced in Nature, as, for example, by a broken bamboo stem. The following extract from Godinho de Eredia's "Report on the Golden Chersonese": 1597–1600 (English translation by Mr. J. V. Mills of the Malayan Civil Service) may be of interest, though it concerns speech, not melody:

"To conclude entirely with the Peninsula, I will relate a curious phenomenon which occurs at the mouth and entrance of the River Panagim [now called the River Linggi. J.B.S.]: here there are dense thickets of Bamboos, and among them are two very tall stout Bamboos which are set in such a manner that one of them towers over the other; now it is an actual fact that by day and by night human voices are heard proceeding from these Bamboos; one of them says '*Suda*', that is to say, '*Enough*', and the other replies '*Bolon*', which is as much as to say '*Not yet*'.

"I always regarded this as a worthless fairy-tale, until Affonso Vicente, Ambassador to Achem, assured me that he personally heard these voices saying '*suda*', '*bolon*', when he went to this place on the Panagim for the sole purpose of observing this most curious occurrence in the year 1595."

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Nov. 6.

An Epithelial Tumour of the Intestine of a Frog

THE following report is made because a similar pathological condition has not previously come to my attention. The frog, *Rana pipiens*, was brought to the laboratory from the frog tanks with a number of others for the use of students. There was nothing in its external appearance to indicate any abnormality. It seemed as well nourished as any. When the abdomen was opened it was found to be nearly filled with an irregularly cubical mass, the liver was much compressed and only about two centimetres of intestine could be found. In colour the mass was pale yellowish brown; its consistency varied, some parts being quite firm to the touch and others cystic. On section, tubular openings coursing irregularly through the mass were disclosed, and where these were near the surface they gave the impression of a cyst when palpated. These tubes appeared to be the missing intestine. The entire specimen was submitted to the Department of Pathology, which reported as follows:

"Large yellowish tumour mass occupying main part of abdomen of frog, with a lumen suggesting intestine.

"Section shows tumour to be of epithelial origin; the cells are arranged in irregular acini suggesting a tumour arising from intestine.

"Epithelial tumour."

It is remarkable that the frog could have lived in spite of the interference with digestion and absorption that would seem inevitable from the presence of so large a mass in the abdomen, and especially of one involving the intestine to so great an extent. Inspection and handling of the voluntary muscles did not reveal any atrophy. I shall be much interested to hear from anyone who has observed a similar condition, and should like to secure all the information possible as to the frequency of occurrence, rate of growth, and effect on health and length of life.

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Oct. 21.

Research Items

Precious Stones in Medieval Folklore.—Dr. J. P. Heather has made a study of the references to precious stones in the middle-English verse of the fourteenth century, comparing these with the treatment of the subject in the Anglo-Norman lapidaries (*Folk-lore*, vol. 42, pt. 3). Although precious stones are connected with animals on many occasions in the verse, especially as similes, reference to the belief, common in the lapidaries, that precious stones were found in the heads of animals, such as toads, vultures, crabs, practically do not occur; yet their frequency in later literature suggests that they were well known among the people. In another direction, stones were connected with Nature. In the works of the poet Gower each of the fifteen stars has its herb and its precious stone, and stones are enumerated as set in the crown of the sun. The first three, Lieuchis, Astrices and Ceramius, "no persone hath upon erthe". Six of the remainder—crystal, adamant, smaragdine, elitropius, jaspis and jacinthus—are well known; but ydriades and dendides are not traceable in the lapidaries. Precious stones have their effect on both men and women in regard to their qualities and character, while some improve their moral qualities. Other stones confer invisibility, or invincibility in combat, or eloquence, and so forth. In virtue of a hyacinth engraved with a figure, half woman and half fish, set in fine gold, covered with wax and held in the fist, "you will be seen of no man". The property of a stone to which reference is made most frequently in verse is that of shining with its own, and not reflected light, this quite overshadowing the magical property, though the latter is well known. Thus the carbuncle in "The Romaunt of the Rose" gives forth a light at night by which "men mighte seen to go, for nede, a myle or two, in lengthe and brede". References to the healing power of the stones are not frequent, though there is abundant evidence that it did exist. In regard to use, reference is most frequent in relation to burial rites.

The State in Ancient India.—The concept of the State in ancient India and the sphere of State-action, topics upon which there is much difference of opinion among European and Indian scholars, is discussed by R. Pratapagiri in the *Journal of the University of Bombay*, vol. 1, pt. 1. The end of the State is to maintain *dharma*, upon which the security and prosperity of the realm depend. The different orders and castes are to be strictly confined to their appointed functions and it is the duty of the king both to protect the four orders in the performance of these functions and to see that they carry them out. Otherwise the State would dissolve into mutually repellent atoms. Further, it is the duty of the king to lead back into the right path any who stray from the rules of their caste or order. The king not only could, but also should, interfere in the most private relationships of life. The only limits to the power of the State are of a theocratic nature. It is the duty of the king to protect the sacred groves and the castes and orders engaged in religious observance. By this protection and restriction he increases the *dharma* in his realm. He is therefore the root of *dharma*. It follows that the ancient Indian State is of the autocratic type and highly centralised, the king being executive, administrative and legislative head, as well as military leader, guiding and controlling the religious, moral and social life of his people. Hence when imperial government was established, and especially under the Mauryan monarchs, the growth of the king's authority led to the establishment of councils and a bureaucratic system which usurped the place of the ancient meetings of the folk. The kingship was not a constitutional institution limited by checks, as some think, but an autocracy of which the only limitation was its end—the maintenance of *dharma*.

Characteristics of Geographical Races of Beetles.—While the geographical variations of morphological characters within a species have been extensively studied, practically no work has been done on the physiological differences between geographical races. A recent paper by Krumbiegel on the races of the beetle *Carabus nemoralis* (*Zoolog. Jahrb., Systematik*, 63, 1932) is largely physiological in its outlook and methods and deserves, therefore, special attention. Temperature reactions of various geographical races of the beetle have proved to be in direct correlation with the climatic conditions of the respective areas of their occurrence. Positive reactions to light increased in their regularity and intensity when a series of races ranging from north European to the Mediterranean were examined. These physiological characteristics were found to change gradually from north to south. Particularly interesting is the fact that two races from widely distant areas can differ physiologically just as much as two distinct species, while morphologically they are clearly conspecific. Moreover, the races which can be easily separated by their reactions towards light are often almost identical morphologically. An exact morphological analysis, however, revealed differences between them, namely, in the shape of the eyes and in their structure.

Control of the Citrus Black Fly in Jamaica.—The citrus black fly (*Aleurocanthus woglumi* Ash.) is one of the major pests affecting citrus trees in Jamaica. The control of this insect by the use of insecticides presents great difficulties, especially as citrus trees in Jamaica are rarely cultivated in regular groves, but are scattered among other trees which also harbour the pest. The question of its control by biological means is discussed by Mr. W. H. Edwards, the Government entomologist, in *Entomological Bulletin* No. 6 (1932) of the Jamaica Department of Science and Agriculture. The recent introduction of the Chalcid parasite, *Eretmocerus serius* Silv., for the purpose of attempting to control the citrus black fly in Cuba, has been attended by remarkable results, since this pest seems to have been eradicated in regions where the parasite was liberated. This outcome naturally suggested trial of the same experiment in Jamaica and supplies of parasitised black fly nymphs were sent by Dr. J. G. Myers from Cuba. Mr. Edwards states that the breeding out of these parasites from the material thus obtained has been successful and that liberations have already taken place in three selected localities. While it is premature to assert whether the parasites will establish themselves under these

new environmental conditions, as successfully as they have done in Cuba, there is every reason to believe that they will do so. If the expected result follows, the introduction should prove of immense benefit to the Jamaican citrus-growing industry.

A New Species of *Coeloplana*.—A single specimen of *Coeloplana metschnikowii* was discovered in the Red Sea and described in 1880, and no other species, indeed no other specimen, was recorded until 1902 when Abbott gave an account of two new species from Misaki, Japan. Since then seven other species have been described, namely, two more from Misaki, two from Annam, two from French Indo-China and one from Amboina. The latest of the four species from Misaki is *C. echinicola* described by H. Tanaka (*Mem. Coll. Sci.*, Kyoto Imp. Univ., ser. B, vol. 7, No. 5, Art. 12, 1932) who obtained specimens on the test of a sea-urchin, *Toxopneustes pileolus*. This species is distinguished by its coloration and by the large number (thirty-two, eight larger and twenty-four smaller) of its dorsal processes. The author states that asexual reproduction by means of laceration occurs especially during the night in early summer. One fairly large individual produced more than ten lacerated pieces in a week but this process ceased after the middle of August and in September this *Coeloplana* disappeared entirely from the littoral zone. In another paper (Art. 11) in the same journal the author gives an account of re-organisation in regenerating pieces of *Coeloplana*.

New Thermophilic Organisms.—During the summer of 1930, Dr. E. Hindle visited the thermal springs at Bax, near Bordeaux, and on the surface of the pool of hot water in the market place noticed a floating scum of organic matter, consisting of blue-green algæ and other filamentous organisms, some of which he collected and brought back for examination (*J. Roy. Micr. Soc.*, vol. 52, pt. 2, 1932). When examined four weeks later, the only obvious living organisms were bacteria, but as the temperature of the thermal pool was about 54° C., some of the material was incubated in boiled tap-water at this temperature for one or two weeks and a variety of micro-organisms developed in the liquid, including at least two groups of which there is only one previous record of their active life at such high temperatures. At least two species of amœbæ were observed in the cultures, one comparatively large, 20–30μ in diameter, the other smaller and probably, from its structure and the absence of any flagellate phase, belonging to the genus *Hartmannella*. The larger species soon died out but the *Hartmannella* has been cultivated and found to be very susceptible to slight alterations in temperature. In spite of abundant growth at 53°–54° C. for nearly a year, all attempts to raise the temperature at which the species would grow by even 1° C. gave negative results; when the temperature was so raised all active forms quickly disappeared. Encysted forms were unaffected and when grown again at 54° C. active amœbæ resulted. The cysts withstand temperatures ranging from below 0° C. to at least 60° C. and dried cysts kept in an unheated shed were found to be alive ten months later. The original material from Bax, when reheated at 54° C., also showed the presence of spirochætes identical with those commonly found in rivers and pools; these thermophilic races have probably been derived from individuals to which such high temperatures would be rapidly fatal.

Bud Mutation in *Ficus*.—Mr. K. P. Biswas, curator of the Herbarium, Royal Botanic Garden, Calcutta, reports an interesting bud mutation on one of the branches of a tree of *Ficus Krishnæ* DC., which has been growing in the nursery of the Garden for thirty-two years. *Ficus Krishnæ* itself is a species of uncertain status and origin. Only ten per cent of the seed breed true, the other ninety per cent give *Ficus Bengalensis* L. The plant was named by C. de Candolle in 1901, but the Indian view is that it is a garden variety of *F. Bengalensis*, and Prof. Molisch when visiting Calcutta in 1929 also considered it a mutation of this species. A bud mutation now developed in the Botanic Garden has broad flat leaves like the leaves of *F. Bengalensis*, and suggests that *F. Krishnæ* may prove to be a chimæra with a core of *F. Bengalensis*. Dr. S. Hidayetulla has taken up the study of the genetics and cytology of this species.

Surveys in South Georgia.—The highly indented coastline of South Georgia affords numerous harbours and anchorages, many of which have been used and roughly surveyed by whalers and exploring expeditions, but most were not accurately charted until the "Discovery" expedition took the work in hand. The results of this work, during such time as was available in the seasons 1926–27, 1928–29 and 1929–30, is now published in the "Narrative of Hydrographic Survey Observations in South Georgia and the South Shetland Islands, 1926–1930, by Lieut.-Comdr. J. M. Chaplin, R.N. (*Discovery Reports*, Vol. 3, pp. 297–344). Some of the work was done in R.R.S. *Discovery* and S.S. *William Scoresby*, but most in a motor-boat. Altogether 357 miles of coast-line were surveyed under conditions of no small difficulty, since on about one day in four the weather prevented work being done. All the harbours were hydrographically surveyed in addition. The volume includes reproductions of the Admiralty charts on which the surveys appear. The work in the South Shetlands was very limited and in the South Orkneys was confined to Borge Bay on Singy Island, which is also known to the whalers as Bruce Bay. In the South Orkneys, practically all the coast-line of Coronation Island needs to be re-surveyed, and in the South Shetlands many corrections will have to be made to charts. Among the photographs reproduced in this volume is a striking one of a discoloured iceberg which shows how ice may be taken for land and explains some of the erroneous landfalls of polar regions.

Schuster-Smith Magnetometer at Helwan.—Continuous terrestrial magnetic registration has now been in progress at Helwan, Egypt, for twenty-four years, and data of great value have been accumulated (though unfortunately the hourly values have not been published). The absolute values of the horizontal and vertical force have been derived hitherto from a Kew magnetometer, but recently the instrumental equipment of the Observatory has been greatly improved by the installation of a Schuster-Smith magnetometer. This is a copy, on a slightly smaller scale, of the original instrument designed at the National Physical Laboratory, with certain improvements. Its constants have not been determined by measuring the dimensions of the coil, but have been obtained by comparison with the standard Schuster-Smith magnetometer at Abinger. Its great advantage is the speed and accuracy of the measures which it

affords. Comparisons of its determinations with those simultaneously made with the Kew magnetometer, over a period of five months, are reported on in Bulletin No. 35 (Cairo, 1932) of the Helwan Observatory; they disclose a difference of about 30γ between the two sets of measures. From January 1, 1932, the new instrument is to be adopted as the Helwan standard instrument.

A Centrifugal Machine for Examining the Adhesion of Layers of Lubricant to Metallic Surfaces.—In a paper read before the Institution of Petroleum Technologists, W. F. Parish and L. Cammen describe a high-speed centrifugal machine, built on the lines of the Sperry gyroscope, and capable of being rotated without appreciable vibration up to speeds of 18,000 revolutions per minute. An oil film present on the rotor of this machine is thrown off in stages, as the speed of rotation is increased. The first portions to fly off are those constituting the thick film responsible for the 'complete' or 'film' lubrication, in which the laws of hydrodynamics hold good. The outer portions of this layer are torn off fairly easily, the inner portions less so, the adhesion to the metal apparently increasing on passing from the exterior to the interior of this fluid film. Possibly the intensity of the attraction to the metal varies as the inverse square of the distance in this region. When the whole of this outer film has been thrown off, there still remains a layer of oil, termed the 'Langmuir' layer, which is many molecules thick, and can be wiped off by a piece of paper. It cannot, however, be thrown off by centrifugal force, until speeds many thousands of revolutions greater than those needed to remove the whole of the 'Coulomb Law' or loosely attached layer are reached. When this 'Langmuir' layer has been removed by wiping, further centrifuging causes a fresh, very similar layer of oil to appear, almost certainly by extrusion of oil occluded in very fine cracks in the metallic rotor. Several such films can be reconstructed from the occluded oil, after wiping off each film in succession after formation. The authors state that the occluded oil is prevented from coming out during the first centrifuging by the restraining effect of the first 'Langmuir' film. The instrument has been used as a means of performing a 'mechanical fractionation' on castor oil, some part of which appears to have a different affinity for the metal from the rest.

Astronomical Topics

The Partial Lunar Eclipse of September 14.—Prof. C. D. Perrine, director of the Cordoba Observatory, sends a note on the final phase of this eclipse. He states that the departing shadow was dark greyish, almost black, and that it was considerably broader than the amount to be expected at the time, which was, however, not accurately noted. Its sharpness recalled a partial solar eclipse. He thinks that it was from fifty to a hundred miles broader than the computed value, and asks what the appearance was to those who saw the maximum phase of the eclipse. This was observed by the writer of this note, and there was an unmistakable sunlit rim at the moon's north limb; it was not measured, but agreed roughly with the predicted amount.

Prof. Perrine notes in his letter that there was still a considerable amount of volcanic ash in the air at the time; if the terrestrial region throwing the shadow had been in his neighbourhood, we might ascribe the broadening of the shadow to this cause; but actually it was far north of the equator, indeed near the arctic circle; the cause therefore is unexplained.

Star of Greatest Known Mass.—A few years ago Prof. J. S. Plaskett announced that the star B.D.+6° 1309, in Monoceros is a very massive spectroscopic binary, the minimum masses of the two components being 76 and 63 times that of the sun; this was the most massive star known, for Miss Maury showed that the mass of some 300 times the sun, announced by Ludendorff for Upsilon Sagittarii, was based on a misinterpretation of the shifts of lines in its spectrum; it is a massive star, but far below Ludendorff's estimate. Dr. J. A. Pearse announces (*Mon. Not. Roy. Astro. Soc.*, Oct.) the detection of another very massive star at Victoria Observatory; this is H.D. 698, magnitude 7, in Cassiopeia; its spectral type is *B9sek*; it is a binary with a period of 55·9 days, eccentricity 0·03; both spectra are visible, but that of the smaller star is faint; the minimum masses are 113·2 and 44·9 times that of the sun. An interesting feature is that for part of the revolution the *K* line of calcium appears triple, the third component being due to interstellar calcium. The strength of the latter line is used to deduce the distance of the star, which comes out as 1220 parsecs. The absolute magnitudes are −3·1 for the brighter star, and −1·6 for the fainter one, which is of type *B5*. The star gives further confirmation of the existence of interstellar calcium. It is only in very distant stars that the lines due to it can be detected, and only in certain spectral types; since if the star has broad calcium lines of its own, these mask the interstellar ones, unless they are separated by rapid motion in the line of sight.

Annual of the Astronomical Observatory of Madrid.—The annual of this Observatory, besides giving the usual information of an astronomical almanac, contains much other interesting matter. There is a table of the parallaxes, magnitudes and spectral types of the 36 newest stars, and another of the elements of comets seen at more than one apparition (there are two omissions, the comets Pons-Coggia-Winnecke-Forbes and Grigg-Skjellerup); there is also a definitive orbit of comet Wilk, 1930 II, by Rafael Carrasco:

$$\begin{array}{ll} T & 1930 \text{ Jan. } 22{\cdot}305227 \text{ U.T.} \\ \omega & \left.\begin{array}{l} 157^\circ\ 29'\ 18{\cdot}78'' \\ 179\quad 0\ \ 11{\cdot}78 \\ 124\ \ 31\quad 0{\cdot}23 \end{array}\right\} 1930{\cdot}0 \\ \Omega & \\ i & \\ \log q & 9{\cdot}8276021 \\ \log a & 2{\cdot}8975315 \\ \text{Period} & 22197 \text{ years.} \end{array}$$

He gave similar elements last year, but the present investigation is more exhaustive, including all known observations. Mr. F. E. Seagrave found a similar period, but he did not include so many observations.

Another useful chapter deals with the families of asteroids discovered by Prof. Hirayama, with diagrams showing how they are grouped. There is also a table of all the asteroids arranged in order of period, which for many purposes is more useful than the order of discovery. Finally, there are details of the observations of solar prominences made at Madrid in 1930.

Archæology of Central America*

IN default of any statement to the contrary, it is to be assumed that "Contributions to American Archæology" is to serve as a medium of publication for results of the activities of the Carnegie Institution of Washington in American archæological investigation which are not on a sufficiently large scale to justify a separate monograph. The magnitude of an excavation, fortunately, is no gauge of its importance, and although neither of the investigations in the field recorded here proved sensational in its results, each makes a contribution to the archæology of Central America of specific interest, if of limited range.

(1) The excavation of mounds at Baking Pot, British Honduras, by Mr. Oliver Ricketson afforded some interesting, if somewhat obscure, evidence bearing on burial customs under the Mayan 'Old Empire'. The mounds in question, situated about six miles from El Cayo, consist of two groups, lying in a clearing, and each surrounded by innumerable small house-mounds. Of these, Group II. was examined superficially only. Group I. consisted of three small plazas on which were a number of mounds or pyramids. A squarish domeshaped mound and a low platform mound on plaza 3 were the sites of the chief excavation. A fire-pit on plaza 2 was excavated to a depth of two metres by the removal of ashes and small flints showing the effects of intense heat. It was too deep for a cooking-pit and may have served as a crematorium.

On excavation, Mound G, the first of the two mounds on plaza 3, proved to be a burial mound, rectangular in outline with offsets on three sides. An unusual feature was the occurrence of several retaining walls of roughly worked stone on the slopes of the mound. If the top of the mound had once been reached by a stairway on the western slope, obviously the side of approach, it must have been of plaster and had vanished.

Fifteen burials were discovered in that part of the mound which was excavated. The last uncovered was apparently that of a person of importance, as it occupied a stone vault centrally situated in the mound and consisting of rough limestone blocks, the inner faces of which had been smoothed. They had been set in mortar and a cover was formed by limestone slabs, of which the edges had not been trimmed. The dimensions of the chamber, which was at a depth of two metres from the surface of the mound, were two metres in length by 45-50 cm. in width by 50 cm. in height. A narrow shelf of stone extending into the grave on both sides at the bottom reduced the width available for the disposal of the body to not more than 39-42 cm.; but its function was not evident. On the floor of the grave beyond the skeletal remains at head and foot were two black tripod pots.

The skeletal remains were badly preserved and offered little opportunity for examination. The body evidently had been laid on its face. With it were ear plugs and crude beads of jade, shell rosettes, fragments of worked bone, eleven small pieces of iron pyrites, and a number of small fragments of jade, round or in thin plaques.

The other skeletal remains found in the mound were in poor condition, and preservation of anything but fragments was in most cases impossible. Ten skulls were recovered in a condition which permitted of partial examination. Six show fronto-occipital deformation in varying extremes. Five are male, four indubitably female, and one probably female. The average cephalic index is 86·37, six ranging above this average to a maximum of 96·8.

The disposition of fourteen of the burials in the earth of the mound, some within, some without the retaining walls, is suggestive. Four are buried so near the surface and in such relation to one another as to suggest that they were sacrificial victims killed and hurled from the top of the mound and then buried as they lay.

Evidence for dating the site is lacking until the pottery has been more closely examined. Though not an important centre, it was evidently thickly populated at some time—it is suggested, on general grounds, not later than the transition between the Old Empire and the New, say the seventh to eighth century A.D.

(2) The study of the astronomical system of the Mayas has amply repaid the great amount of time and thought that has been spent upon it. The present work brings out the striking fact that the Mayas adopted the position value of numerals, with its necessary adjunct, a sign for zero, at least a thousand years before this step was taken in Europe. Their numerical system, which takes twenty as its base, is now thoroughly understood, and has brought to light the accurate knowledge that the Mayas attained with regard to the heavenly movements. Dr. Teeple gives 365·2420 days as the Maya determination of the length of the tropical year; this is about as accurate as the mean length of the Gregorian year, which is 365·2425 days; the truth lies midway between them; "but the Maya figure was reached a full thousand years before the Gregorian one".

In spite of this knowledge, the Maya appear to have used the 365-day year, letting the seasons drift round it; they also used a second reckoning by 260-day periods, called *tzolkins*; thus 73 *tzolkins* are exactly 52 of their years. No natural period coincides with the *tzolkin*, but it is very close to three-quarters of the eclipse-year, or interval between successive passages of the sun through the moon's ascending node. The Dresden Codex, the date of which is given as about A.D. 1100, is concluded to be an eclipse table. The mean length of the lunation was not so well determined as that of the tropical year. Two different values are mentioned, one being a day wrong in two centuries, the other a day in three centuries. Five Venus revolutions (synodic) were taken as equal to eight of their 365-day periods; this is right within a few hours.

Dr. Teeple has made great endeavours to correlate Maya dates with our calendar, but is at present not quite confident of the accuracy of the relation that he gives provisionally, though he has little doubt that the matter will eventually be settled. A hopeful point is that a total eclipse of the sun is calculated to have occurred on July 16, A.D. 790, on the site of a monument concluded to record an eclipse. The date agrees with Mr. Goodman's correlation.

(3) The excavation of the building since known as "the Temple of the Wall Panels" at Chichen Itzá, was undertaken as a part of the intensive campaign of excavation by the Carnegie Institution on that site. Its specific object was to further the investigation of the fusion of the Nahua and Mayan architectural systems which took place when, in the last 250 years before Chichen Itzá was abandoned in the middle of the fifteenth century, the city reached the height of its glory as a religious centre under alien overlords of

* Contributions to American Archæology, vol. 1, Nos. 1-4. No. 1: Excavations at Baking Pot, British Honduras, by Oliver Ricketson, Jr.; No. 2: Maya Astronomy, by Dr. John E. Teeple; No. 3: The Temple of the Wall Panels, Chichen Itzá, by Karl Ruppert; No. 4: Notes on the Metates of Chichen Itzá, Yucatan, by Gustav Strömsvik. (Publication No. 403.) Pp. iii+157+49 plates. (Washington, D.C.: Carnegie Institution, 1931.)

Mexican extraction. It was in this period that there was an outburst of architectural activity, in which the fundamental conception was Mayan, but the presence of an alien influence is to be seen in serpent columns, sloping lower walls, and other features.

The Temple of the Wall Panels was chosen for excavation on account of its central position in what is known as the Monjas group. This group would appear to have been the nucleus of the city, as it contains most of the pure Mayan buildings of Chichen Itzá, as well as structures that are doubtful and others that are certainly Nahua. The Temple of the Wall Panels was seen to be late from the presence of the drums of round columns on the mound; but beyond the fact that it was small, before excavation nothing was to be seen of its original plan or elevation. When finally cleared, it was found to face west and to consist of a solid pyramidal substructure surmounted by a temple, with a colonnade, forming an integral part of the building, lying directly to the west. The entire edifice rests on a terrace reached by two steps. The temple consisted of two chambers, each covered by a vaulted roof. Of the outer facing, little remains. In the debris of the talus on the northern and southern sides were discovered sculptured stones from panels and mask elements which had fallen from the outer walls. Two warriors are represented on the north panel, one having a long-nose head and an elaborate feathered headdress. The figures are the full height of the panels.

The entrance to the outer chamber is by a triple doorway, 6·71 metres wide, divided by two round columns. Each chamber has a crude shrine or altar. In the inner room a beautifully carved stone was discovered, the figures representing warriors.

In excavating the colonnade, of which the roof probably formed the approach to the temple, sculptured stones were found which had fallen face down. They were for the most part in sequence and have been fitted together. They proved to be elements of the panels of the exterior walls. They were not executed with that fineness of which the Chichen Itzá artists were capable, and it is evident that for detail and finish dependence was placed on the stucco, of which some still adheres to the stone. These panels are elaborately carved with numerous figures of men and animals.

Certain features justify the assignment of the temple to the Nahua period. These are the colonnade, serpent columns, roof *adornos*, a battered basal zone, sculptured panels depicting feathered serpents, the accoutrements of the warriors, and the sun-disk motive. The Atlantean figures which form part of the Nahua sculptural complex are here represented only in a column drum which had been re-used. This presupposes the building and razing of a structure of Nahua type before the erection of the Temple of the Wall Panels.

(4) The metate or milling stone upon which the peoples of aboriginal America grind their maize-corn was, and still is, among many of the Indian tribes the most important article of household equipment. Except for certain ceremonial examples from Central America, it is normally of simple and purely utilitarian form. This typological stability gives it a peculiar archæological significance, as it is little likely to be affected by fortuitous circumstance. It is therefore an admirable source of evidence for certain fundamental groupings. The metates of Chichen Itzá are considered by Dr. Strómsvik as falling into a classification of 'heavy grooved type', 'three-legged ungrooved large type', and 'three-legged ungrooved small type'. While suggesting the intrusion of an alien influence, he points to the necessity of more data on the distribution and cultural affinities of grooved and ungrooved metates in Mexico and Central America.

The A.I.V. Process of Conserving Green Fodder

IN these days of economic nationalism and of devalued currency in terms of gold, it is a cardinal principle to produce as much at home as natural conditions allow. Although only the Dr. Panglosses believe that Great Britain could feed her people entirely and adequately from her own resources, yet all who have studied the question think that we could go a long way towards this goal. Great Britain, for example, is one of the most favoured nations in regard to grass production, yet it imports many million pounds' worth each of butter, cheese, eggs, meat, and concentrated feeding stuffs which could be produced at home. The annual bill for imported concentrated foods is so high that efforts have been made recently to dry artificially the young, protein-rich grass and so conserve it for winter 'keep'. Up to date, experiments made with this object in view in Germany and Great Britain have failed to bring conviction to the economist, and it now looks as if the desired end is to be achieved by a modification of the old practice of ensiling. The ensiling of green fodder crops for use as winter keep has made great headway in New Zealand, the United States, Holland, and Germany, but the English farmer has been slow to realise its advantages. However, he has now an opportunity. Thanks to the enterprise of Imperial Chemical Industries, Ltd., a new chemical method of ensiling, which hails from Finland, has been launched in Great Britain, large-scale experiments having been undertaken at the company's research station at Jealott's Hill, Berks, and at various other places.

When ensilage is made in the ordinary way, in tower, stack, or pit, the green fodder undergoes various changes, due to enzymes and bacteria, which usually entail a loss of 15-30 per cent of its nutrients, and much more if anything goes wrong with the process. In the new Finnish process—called the A.I.V. process, after the initials of the discoverer, Prof. A. I. Virtanen —such changes are inhibited by maintaining the fodder at a hydrogen ion concentration of 3-4. This is achieved by spraying a dilute acid liquor on to the green crop as it is charged into a pit silo; and mould-growth is prevented by spraying the top layer with an anti-mould preparation, called 'Homesurma' (mould-death). The composition of the acid liquor is not revealed, but it is stated to consist mainly of hydrochloric acid, whilst 'Homesurma' is said to consist chiefly of allyl mustard oil. When the pit is fully charged, it must be sealed on the top as tightly as possible, for example, by means of sacking covered with clay or loam, as ingress of air is fatal to success. According to Prof. Virtanen, A.I.V. fodder contains a much higher content of digestible protein than ordinary silage; and he estimates the loss of nutrients in the preparation to be 0·2 per cent from respiration, nothing from decomposition of proteins, and 1·3 per cent from escaped juice.

The A.I.V. process has achieved remarkable success in Finland, where it has been taken up by the butter co-operative export society, Valio, which controls 90 per cent of the butter exported from that country. In 1927 and 1928, the process was being worked out

and tested mainly in the laboratory; in 1929, it was used on 3000 farms, and 30,000 metric tons of A.I.V. fodder was produced; in 1931, 100,000 tons was made on approximately 10,000 farms; and in 1932 the process is being used on 13,000 farms. All kinds of green crops have been ensiled, but legumes or young grass are best for feeding to milch cows.

The ordinary winter ration used in Finland for 800-gallon cows consists of concentrates, turnips, hay and straw: in the A.I.V. ration, all the turnips and much (in some cases all) of the concentrates are eliminated, together with much of the hay. Expenditure on imported concentrates has been reduced by 50-80 per cent, and at the same time the milk yield has increased. The animals readily eat the fodder, ensiled grass being preferred. The free acid is said to disappear before the fodder is fed, but on most of the Finnish farms using the process a small amount of chalk is included in the silage ration. It has been found that the animals do not tire of A.I.V. fodder, and that their general health remains excellent: the distribution of lime and phosphorus in the teeth and bones, and of lime, phosphorus, and chlorine in the muscles and blood, remains normal. The quality of the milk resembles that of summer milk, both the butter-fat and protein contents being slightly higher than when the cows are fed on the ordinary winter ration; and the butter made from winter milk lacks its usual brittleness owing to the oleic acid-content being maintained at summer level. Further, the high vitamin content is held to be of great importance to public health, as the majority of the inhabitants of northern countries rely mainly on milk and milk products for their supplies of vitamins A and D, and hitherto it has been found that the growth of children in Finland is practically confined to the months from July to December.

The only capital cost involved is that of making the silo pit, which has a diameter of 16½ ft. and a depth of 4 ft. 9 in. In Finland, where family labour is abundant and wood is cheap, this cost is very low. Unless the subsoil is chalk, the pit must be lined with wood, or with cement if there is danger of water seepage. A light wooden superstructure, which is transferable from pit to pit, must also be provided; it is placed over the pit when the green material reaches the ground level, and filling then proceeds until the superstructure is also full. The fresh material is then weighted, in a day or two it sinks to the ground level, and the superstructure is removed. Working costs vary with the crop ensiled, the yield per acre of the crop, and with the cost and efficiency of the labour. With labour, as in England, at about *8d.* per hour, the cost per ton of dry matter (about twenty per cent of the green weight) is estimated to be about *22s. 6d.*; if to this figure we add £2 per ton of dry matter as the inclusive cost of growing grass for ensilage with the aid of manures, we obtain a total of £3 *2s. 6d.* per ton, to which must be added a further small sum for cost of acid and depreciation of the silage pit.

Large-scale trials of the process are being made in Denmark as well as in Great Britain; in addition, the process has found a footing in Sweden and Norway; whilst in Germany, where some of Prof. Virtanen's claims are contested, the process, in its essential principles, has been officially adopted and is being widely advocated. If found to be a success in Great Britain, the adoption of the process will not only save the country millions of pounds per annum on imported concentrates, but will also provide what appears to be the only practical, economic solution of the problem of utilising flush growth of grass, which is one of outstanding importance in the management of grassland.

Buffalo-Fly in Northern Australia

FOR years past, serious complaints have come from cattle raisers in the northern areas of Australia about heavy economic losses due to irritation of stock by the buffalo-fly. This led the Commonwealth Council for Scientific and Industrial Research in 1930 to invite Prof. Eduard Handschin, of Basle, to undertake inquiries in Java and neighbouring islands, as well as on the mainland. The object was to examine possibilities of parasitic control of the pest. Prof. Handschin's full report is not yet available, but it is of interest at this stage to record some of the results of his eighteen months' work.

As with other alleged economic pests in Australia (flying fox, for example), careful inquiry has shown that *Lyperosia exigua* de Meijere, though serious in some places, is by no means responsible for all the damage hitherto attributed to it. This fly is present everywhere in the Dutch East Indies, where it is not regarded as a pest: its bad name in Australia is due in part to faulty observation. March and bush flies (*Tabanus* and *Biomyia* spp.) worry cattle more, in Handschin's opinion, than does *Lyperosia*. Loss of condition in travelling mobs is often put down to 'fly worry' when it is due rather to innutritious dry grass and water scarcity. Further, the quality of the stock in northern Australia is admittedly low. This undoubtedly increases the attractiveness, or susceptibility, of the cattle to the fly. Poor quality of stock is probably a cause rather than an effect of the abnormally heavy infestation that is frequently observed. In short, it is usual to attribute all fly damage to *Lyperosia* and to make it the scapegoat for every economic loss in northern Australia.

Nevertheless, it remains a distinct menace to cattle-raising, and its passage eastwards into the dairying herds of the coastal areas of Queensland might have serious results. Such spread is already occurring, but its geographic limits are set by conditions of temperature and humidity. The influence of these on time of development has been partially worked out by Handschin, who feels justified in maintaining that the buffalo-fly will never become established in the more southerly parts of Australia (western or eastern) and probably never farther south than Rockhampton in Queensland. There may be temporary incursions to lower latitudes, but they will not survive.

In the sparsely settled areas of the north, parasitism seems the only possible means of control. Nieschulz had already found a number of parasites in Java, mostly primary parasites of saprophagous *Muscidæ*, not confined to any species of these, but as easily bred on *Lyperosia* as on them. Twelve of them were reared in the laboratories of the Veterinary Research Institute at Buitenzorg, and *Spalangia sundaica* Graham (n. sp.), which was the must abundant in the field, offered the greatest promise as a possible control for *Lyperosia*. The female lives about 27 days and lays 160-170 eggs, each in a separate puparium of a fly.

There is a northern Australian species tentatively named *S. orientalis* Graham (n. sp.), morphologically quite distinct from *S. sundaica*, the female of which lives for 15 days and lays 75-85 eggs. In the hope of producing a more effective race, Handschin endeavoured to cross these two species. Males only were produced, indicating that fertilisation had not occurred. In the meantime, however, a special strain

of *S. sundaica* was reared for several generations on *Lyperosia* puparia only, and when the male of this was crossed with *S. orientalis* female, remarkable results were obtained, the female offspring living 32 days (instead of 15) and producing 250 eggs (instead of about 80). In other words, the time of life of the indigenous species was doubled and the fecundity trebled, both highly important characteristics in a fight against *Lyperosia*. The reverse cross gave females living only 10 days, instead of the 27 of the *S. sundaica* female, and producing 100 eggs instead of 180.

Five generations of the more promising cross were bred by Handschin, using all possible combinations of the parent and derived stock. The results are certainly striking, but further research is urgently necessary. Arrangements are in train for breeding the first cross and releasing it in selected areas near Darwin. If results justify it, the work will be extended in the wet season to the Gulf Country in North Queensland. The chances of appreciable success are, however, not great; hence no relaxation of quarantine restrictions can be permitted. An interim report on Handschin's observations, including descriptions of *S. sundaica* and *S. orientalis*, has been published.

A. C. D. R.

Liquid Fuels

THE second jubilee memorial lecture to the Society of Chemical Industry, given by Dr. A. E. Dunstan, deals with the whole question of the utilisation of petroleum, oil from coal, synthetic oils, and related subjects, and is printed in *Chemistry and Industry* for October 7 and 14. Natural gas is also dealt with.

Dr. Dunstan pointed out in what directions the industrial processes are undergoing modification. In the case of motor spirit, the tendency to gum formation, which is always present to some extent, is minimised by the addition of inhibitors such as di- and tri-hydric phenols and some aromatic amines and derivatives. Tendency to freezing in the case of spirit for use in military aviation is overcome by blending with methyl and ethyl alcohols, the hygroscopic properties of which may be restrained to some extent by the addition of benzene, amyl and butyl alcohols and phenol as binders.

A limit appears to have been reached in the increase of compression ratio possible without detonation even when special fuels are used, and research into the effects of other factors in engine design is suggested. The relation between chemical composition (paraffinic, naphthene, aromatic) and tendency to detonation in a fuel is not absolute, and anti-knock valuation can be made only by engine tests. The restriction on the use of cracked spirit for aviation may be removed if the authorities can be satisfied as to its keeping properties. Compression ignition (Diesel type) is steadily advancing in importance as compared with spark ignition, particularly for heavy transport, and Dr. Dunstan pointed out its advantages. Even if the price of fuel were equal to that of petrol, there would still be a very substantial margin of benefit from compression ignition. The bearing of this on the liquid fuel industry was made clear.

The production of oil from coal was carefully discussed and the conclusion reached that it appears to represent strategic rather than economic advantages. If the total coal used for power, heating, etc., as well as hydrogenation is taken into account, the most successful processes of hydrogenation will at present make only 1 ton of oil from 4 tons of coal, and the plant is not only extremely complicated but also exceedingly costly. Although hydrogenation appears to be the most hopeful line technically for the production of liquid fuels, its application to coal or even tar cannot be put forward at the present stage as a business proposition.

University and Educational Intelligence

BIRMINGHAM.—The Huxley lecture is to be delivered by Sir Arthur Salter in the Medical Theatre of the University, Edmund Street, on December 1 at 5.30. The subject of the lecture is: "Next Steps in World Recovery".

CAMBRIDGE.—Sir Charles Sherrington, Waynflete professor of physiology in the University of Oxford, has been appointed Rede lecturer for the year 1933.

W. G. Walter, of King's College, has been elected to the Michael Foster research studentship in physiology.

Dr. E. T. S. Walton, of Trinity College, has been awarded the Clerk Maxwell scholarship.

The Adam Smith prize has been divided between K. S. Isles, of Gonville and Caius College, and J. H. Kirk, of King's College.

Dr. N. J. T. M. Needham, of Gonville and Caius College, has been approved for the Sc.D. degree.

The Governing Body of Emmanuel College invites applications for a research studentship which will be awarded in July 1933. The award will be made on evidence submitted by the candidates which should include (1) a birth certificate, (2) two certificates of good character, (3) a statement of the proposed course of research, (4) evidence of general ability and of special fitness for the proposed course of research, supported by letters from two professors and other teachers, (5) a statement of emoluments or awards, already granted, or likely to be granted, from other bodies or persons and tenable at Cambridge. Applications must be sent to the Master in time to reach him not later than June 30. Preference will be given to candidates who have already completed one but not more than two years of research. The studentship has a maximum annual value of £150 and is awarded and normally held for two years but may be renewed for a third year. The studentship is not tenable by a woman or by a graduate of the University of Cambridge.

LONDON.—The University Court has gratefully accepted an offer received from Mr. William Page to give to the University, subject to certain conditions, the copyright and material of the Victoria County History.

THE building extension of the Northampton Polytechnic Institute, St. John Street, E.C.1, will be officially opened by H.R.H. Prince George on December 2, at 7 P.M.

THE twentieth election to Beit fellowships for scientific research will take place on or about July 14, 1933. Not more than three fellowships will be awarded on this occasion. Candidates must be graduates of a university of the British Empire and under twenty-five years of age. The annual value of a fellowship is £250 and it is tenable at the Imperial College of Science and Technology. Further information can be obtained from the Rector, Imperial College, South Kensington, London, S.W.7.

Calendar of Geographical Exploration

Nov. 21, 1793.—Japan and Russia

A storm drove a Japanese vessel carrying rice to Yezo far out to sea, and in early June of the following year the Japanese sailors reached the Aleutian Islands, recently taken by the Russians. They remained there some ten months and reached Okhotsk at the end of June of the next year. Thence they were taken overland to Irkutsk, where they remained eight years. They were then taken to St. Petersburg, where the Czar received them and gave them furs. Finally they were sent back by sea round Cape Horn to Japan with Capt. Krusenstern's expedition, which was intended to conduct a Russian envoy to Japan. They were handed to the Japanese authorities in 1805. A Japanese work written in 1830, in four volumes, describes their experiences. It is also interesting to note that Krusenstern's voyage was the first Russian circumnavigation of the globe. He left Kronstadt in 1803, rounded Cape Horn, made some observations in the Marquesas Islands and thence proceeded to Kamchatka and Japan; he examined the strait between Sakhalin and the mainland but thought that Sakhalin was a peninsula of Asia. Lisianski, who accompanied Krusenstern in another vessel, discovered the island named after him. The Russian voyage added much to the scientific knowledge of the Pacific; observations of temperature in deep waters and of currents and tides were taken and astronomical records were kept.

Nov. 21, 1754.—Basin of the Saskatchewan

Anthony Hendry, on an expedition for the Hudson Bay Company, reached his farthest west, about 114° W., a little south of 52° N. Hendry left York Factory at the mouth of the Hayes River in June 1754, and using various portages reached Moose Lake and the Saskatchewan River. He explored the region between the north and south branches of that river, spent the winter with the Blackfeet Indians and returned via the Red Deer River to the South Saskatchewan.

Nov. 23, 1878.—British Honduras

Henry Fowler, the Colonial Secretary, started from Belize, went up the Belize River and explored much of the previously unknown interior. Capt. T. A. Joyce, of the British Museum, has carried out important archæological work in this region in recent years, disclosing a great wealth of Maya ruins. These surveys have also contributed to geographical knowledge of a little-known region.

Nov. 25, 1913.—Gertrude Bell in Arabia

Gertrude M. L. Bell arrived at Damascus, whence she set out on her 1500 mile journey in Arabia. She travelled to Hasan near Teima and thence turned east, reaching Hayil, which had only once previously seen a European woman, Lady Anne Blunt, who had visited it in 1878. The cool reception which she received here made it impossible for her to go south as she had hoped and she turned north-east to the Euphrates, returning to Damascus via Bagdad and Palmyra. Her Arabian experiences began in 1899; her subsequent travels and archæological explorations made her reputation as an authority on Asia Minor and the northern borderlands of Arabia. She died in Bagdad in 1926 while engaged in the organisation of a museum of antiquities.

Societies and Academies

LONDON

Royal Society, Nov. 10.—Lord Rutherford, C. E. Wynn-Williams, W. B. Lewis and B. V. Bowden: Analysis of α-rays by an annular magnetic field. With the assistance of Dr. J. Cockroft, an electromagnet has been designed which provides a uniform magnetic field, of the order of 10,000 gauss, in an annular gap in which α-rays can be bent into a circle of 40 cm. radius. The particles are emitted from a source placed in the gap, and are detected by a small ionisation chamber symmetrically situated on the opposite end of a diameter. The interior of the whole magnet is exhausted to a low pressure (0·001 mm. mercury). As in previous experiments the ionisation chamber is connected to an amplifier, and individual α-particles are automatically counted by a system of thyratrons. The analysis is carried out by adjusting the magnetic field so as to bring groups of different velocities successively on to the slit of the counting chamber, the high velocity edge of a group being very sharply defined. Moreover, it is necessary to measure small changes of the magnetic field with great accuracy. A special method has been developed for this purpose, and the relative velocities of a number of α-particle groups have already been determined with an accuracy of about 1 in 3,000. The weak group of α-particles from radium C, numbering only 1 in 4,000 of the main radium C′ group, comprises two distinct components.—**W. A. Bone, D. M. Newitt and D. T. A. Townend**: Gaseous combustion at high pressures (14). Explosions of hydrogen–air and carbonic oxide–air mixtures at initial pressures up to 1,000 atmospheres. With regard to the actual explosions it was found that:—(1) In those of theoretical hydrogen–air media there was a quite definite increase in the explosion times with density at initial pressures exceeding 250 atmospheres; although at 750 atmospheres detonation was instantaneously set up at the firing point with such violence as to preclude work at any higher pressures; (2) in explosions of theoretical carbon monoxide–air media the characteristic lag in the explosion time, as well as the exothermic effects observed during the cooling period—both of which had hitherto consistently increased with the density—reached their maxima at an initial pressure somewhere between 350 and 500 atmospheres, and thereafter remained constant up to 1,000 atmospheres, indicating that the nitrogen activation effect had reached maximum within this density range; (3) in $2CO + O_2 + 3{\cdot}76CO$ explosions the explosion times, which were always very much shorter than in the corresponding $2CO + O_2 + 3{\cdot}76N_2$ explosions and had remained nearly constant up to initial pressures of 250 atmospheres, began definitely to increase thereafter with the density, and about the same point some slight carbon deposition began to be manifest during the explosions, the two circumstances probably being connected. The rates of pressure fall during the first second of the cooling period immediately after the attainment of maximum pressure were always much faster than in the corresponding $2CO + O_2 + 3{\cdot}76N_2$ experiments.

Society of Public Analysts, Nov. 2.—Theodore Rendle: Observations on changes in raspberries after picking. The ripening process in raspberries is more rapid than in most fruits. Accompanying the ripening

there occurs the production of a relatively large amount of volatile organic bodies not due to the action of micro-organisms. The pectic substances in raspberries are subject to rapid change, with the destruction of their gelling power; this change is arrested by the application of heat.—**W. R. Schoeller** and **H. W. Webb**: The separation of uranium from tantalum, niobium and titanium. Uranium is quantitatively precipitated by tannin from neutralised tartrate solution in presence of ammonium acetate and chloride. It is quantitatively precipitated from oxalate solution by tannin and a slight excess of ammonia. Uranium, like zirconium, thorium, aluminium and iron (group *B*) can be quantitatively separated from tantalum, niobium and titanium (group *A*) by tannin precipitation of the last three elements from feebly acid oxalate solution half-saturated with ammonium chloride. In tartaric hydrolysis, uranium interferes with the normal course of precipitation in the case of niobium, but not of tantalum or of mixed pentoxides in which tantalic oxide preponderates.—**E. J. King**: A new form of filter stick: its use in gravimetric analysis. A new form of filter stick, particularly suitable for the micro-analysis of silicic acid, has been devised.—**F. J. Warth**: A new method for the iodimetric titration of phenols. The conditions under which iodine is absorbed by phenols are discussed. Under certain specified conditions, in the presence of sodium hydroxide two-thirds of the theoretical amounts of iodine are absorbed by phenols, including the cresols.

PARIS

Academy of Sciences, Oct. 10 (195, 589-632).—**Maurice Fréchet**: The behaviour of certain nuclei of Fredholm repeated indefinitely and the probabilities in chain.—**J. Mirguet**: A class of surfaces admitting a continuous tangent plane.—**A. Kulakoff**: The relations between the real parts of the characters of groups.—**Pierre Dive**: The identity of two bodies possessing the same Newtonian potential in a common interior region.—**J. Pérès** and **L. Malavard**: The application of the electrical method to a problem concerning the wing of finite spread.—**Li Hen**: Some statistical properties of the Cepheids.—**P. de Fonbrune**: A new micro-manipulator. A pneumatic control is described possessing the advantages that the needle or micro-pipette is unaffected by shaking of the hand; all movements of the control lever are exactly reproduced on the microscopic scale by the needle point. More than one of these instruments can be used in the field of the objective at the same time.—**A. Piccard** and **M. Cosyns**: The study of the cosmic radiation at great altitudes. Results obtained during the ascent made on August 18, 1932. A curve is given showing the relation between the barometric pressure and the intensity of the radiation, the latter measured by two types of ionisation chamber. As regards the effects of screens, 4 cm. of paraffin had no visible effect, but 4–5 cm. of lead caused a diminution of 20–35 per cent.—**Mlle. Suzanne Veil**: The periodic precipitation of some silver salts. Study of the precipitation of silver arsenate, chromate and phosphate in gelatine.—**Kapp**: The determination of hydrogen sulphide in trade effluents. The errors caused by the oxidation of the gas by the oxygen dissolved in the effluent can be avoided by adding cadmium sulphate: cadmium sulphide is not readily oxidised and can be carried to the laboratory for analysis without change.—**A. Stieber**: Two combinations of boron trichloride, one with hydrogen arsenide and the other with phosphorus trichloride. These new compounds have the formulæ $BCl_3.AsH_3$ and $BCl_3.PCl_3$.—**G. Schuster**: The use of hydrobromic acid for the characterisation of the arylarsinic acids.—**G. Florence, J. Enselme** and **M. Pozzi**: Contribution to the study of the variations as a function of the *p*H of the ultra-violet spectra of some hexavalent heterocyclic compounds.—**J. Durand**: The granite of Laguépie (Tarn-et-Garonne).—**J. Malavoy** and **S. Serpokryloff**: New geological observations in the loop of the Niger.—**F. Link**: Records of atmospherics. The observations were made at the Observatory of the Pic-du-Midi at an altitude of 2,860 metres, between November 1931 and August 1932. A statistical study of the results gave maxima corresponding to heights of 35 km. 115 km. and 235 km. The first maximum corresponds with the maximum ozone concentration, the second with the Kennelly-Heaviside layer and the third to the reflecting layer found by the echo method.—**Paul Chauchard**: The variations of salinity measured by means of the electrical conductivity: study of the Rance at Le Chatelier.—**N. Em. Renescu** and **B. B. Olszewski**: Chloral hydrate in the organism. The narcotic action of chloral hydrate has been variously attributed to chloroform produced by decomposition, to the formation of carbon monoxide, and to the effects of unchanged chloral hydrate. The author's experiments are in agreement with the last view. Chloral was found in relatively large quantities in all the organs, whilst chloroform was found in traces only and was absent from some organs.—**J. R. Denis, P. Paris** and **P. Rémy**: New experiments, under natural conditions, on the phototropism of fresh-water plankton.—**Emile André** and **Armand Bloch**: The etho-esters of glycerol or etho-glycerides of the liver oil of *Scymnorhinus lichia*.—**M. Aynaud**: The parasitism of Infusoria in the walls of the stomach of the sheep.—**A. Lacassagne**: The appearance of cancer of the breast in male mice, submitted to injections of folliculin.

Forthcoming Events

MONDAY, Nov. 21

ROYAL SOCIETY OF ARTS, at 8—(Fothergill Lecture).—Com. A. N. G. Firebrace: "Fire Fighting".

CHADWICK PUBLIC LECTURE, at 7.30—(at the Technical College, Bradford).—Prof. S. D. Adshead: "Some Recent Developments in the Housing Problem".

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Evelyn Cheesman: "The Island of Malekula, New Hebrides".

TUESDAY, Nov. 22

BRITISH SCIENCE GUILD, at 4.30—(Eighth Annual Norman Lockyer Lecture, in the Goldsmiths' Hall, Foster Lane, E.C.).—Sir Frank Smith: "Industrial Research and the Nation's Balance Sheet".

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30—(at the School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Gabrielle M. Vassal: "Life in the French Congo".

KING'S COLLEGE, LONDON, at 5.30.—M. T. Halcrow: "The Water Power Developments of the British Isles" (succeeding lectures on Nov. 29 and Dec. 6).

UNIVERSITY OF LEEDS, at 8.—Dr. C. D. Ellis: "Recent Advances in our Knowledge of the Atom".

WEDNESDAY, Nov. 23

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5—(at the School of Hygiene and Tropical Medicine, Keppel Street, W.C.1).—Discussion on "The Evidence of Man's Kinship with the Primates", to be opened by Dr. Solly Zuckerman.

FRIDAY, Nov. 25

Chadwick Public Lecture, at 7.30—(at the Town Hall, Gateshead).—Dame Louise McIlroy: "Maternal and Infant Welfare".

Chemical Society, at 5.30—(Fourth Liversidge Lecture, in the Chemistry Lecture Theatre, University of Birmingham).—Dr. F. W. Aston: "Physical Atomic Weights".

University College, London, at 5.30.—Sir James Frazer: "The Fear of the Dead in Primitive Religion" (succeeding lectures on Nov. 29 and Dec. 1).

Royal Institution, at 9.—Dr. H. Knox-Shaw: "Observational Evidence for the Expansion of the Universe".

SATURDAY, Nov. 26

University of Cambridge, at 5—(Henry Sidgwick Memorial Lecture in the College Hall, Newnham College).—Sir James Jeans: "The Farthest Depths of Space".

Official Publications Received

GREAT BRITAIN AND IRELAND

Birmingham Bureau of Research on Russian Economic Conditions. Memorandum No. 7: i. Foreign Trade; ii. Monetary Conditions; iii. Indices of Wholesale Prices; iv. State Budget. Pp. 24. (Birmingham: The University.)

Medical Research Council. Special Report Series No. 174: Medical Uses of Radium; Summary of Reports from Research Centres for 1931. Pp. 59+4 plates. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

Journal of the Chemical Society. October. Pp. iv+2505-2667+viii. (London: Chemical Society.)

University of Reading: The National Institute for Research in Dairying. Annual Report for the Year ending 31st July, 1931. Pp. 90. (Reading.)

Proceedings of the Royal Society of Edinburgh, Session 1931-1932. Vol. 52, Part 3, No. 21: Relative Co-ordinates. By A. G. Walker. Pp. 345-353. 9*d*. Nos. 22 and 23: Tables of the Elliptic-cylinder Functions and Zeros and Turning Points of the Elliptic-cylinder Functions. By Dr. E. L. Ince. Pp. 355-433. 7*s*. No. 24: Adrenaline and the Œstrous Cycle in the Mouse. By Dr. J. M. Robson. Pp. 434-444. 1*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1932. Vol. 44, No. 9, October. Pp. 427-474+xxxiv. (London.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1472 (T.3246): Measurement of Position Error on High Speed Aircraft. By R. K. Cushing. Pp. 5+5 plates. 6*d*. net. No. 1487 (S.91): Effect of Float Setting on Take-off and Top Speed of the IIIF. By J. L. Hutchinson. Pp. 2+1 plate. 3*d*. net. (London: H.M. Stationery Office.)

A Mosquito Summary. By John F. Marshall. Pp. 8. (Hayling Island: British Mosquito Control Institute.) 9*d*.

A Report on the Museums of Canada, by Sir Henry A. Miers and S. F. Markham, to the Carnegie Corporation of New York, to which is appended a Directory of the Museums of Canada and other parts of the British Empire on the American Continent. Pp. vi+63+2 plates. Directory of Museums and Art Galleries in Canada, Newfoundland, Bermuda, the British West Indies, British Guiana and the Falkland Islands. Compiled by Sir Henry A. Miers and S. F. Markham. Pp. 92. 5*s*., with Report. (London: The Museums Association.)

OTHER COUNTRIES

The Imperial Council of Agricultural Research. Scientific Monograph No. 3: The Open Pan System of White Sugar Manufacture. By R. C. Srivastava. Pp. vi+141+7 plates (Calcutta: Government of India Central Publication Branch.). 3.2 rupees; 5*s*. 6*d*.

Education, India. Education in India in 1929-30. Pp. iv+76. (Calcutta: Government of India Central Publication Branch.) 1.4 rupees; 2*s*.

Report of the Botanical Survey of India for 1930-31. Pp. 12. (Calcutta.)

Survey of India. Geodetic Report, Vol. 7, from 1st October 1930 to 30th September 1931. Pp. xvii+150+29 plates. (Dehra Dun.) 3 rupees; 5*s*. 3*d*.

State of Illinois: Department of Registration and Education: Division of Natural History. Bulletin, Vol. 20, Article 1: Initial Studies of American Elm Diseases in Illinois. By Hubert A. Harris. Pp. iii+70. (Urbana, Ill.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 14: Variations in the Properties of the Cotton Fibre in relation to its Position on the Surface of the Seed. Part 1: Fibre-Length; Part 2: Fibre-Weight; Part 3: Fibre-Strength. By Ram Saran Koshal and Dr. Nazir Ahmad. Pp. ii+56. (Bombay.) 1 rupee.

L'Influence solaire et les progrès de la météorologie: résultats de 50 années d'observations solaires et météorologiques comprenant les observations et les recherches effectuées à Talence à partir de 1900. Par Henri Mémery. Pp. iv+23. (Talence: Observatoire de Physique solaire et de Météorologie.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 9, No. 4, October, Research Papers Nos. 482-492. Pp. 457-582. (Washington, D.C.: Government Printing Office.) 25 cents.

Proceedings of the American Philosophical Society. Vol. 71 No. 6. Pp. 309-410. (Philadelphia.)

Veröffentlichungen aus dem Kaiser Wilhelm-Institut für Silikatforschung in Berlin-Dahlem. Herausgegeben von Prof. Dr. Wilhelm Eitel. Band 5. Pp. iv+212. (Braunschweig: Friedr. Vieweg und Sohn A.-G.) 28 gold marks.

Annals of the Observatory of Lund. No. 3: Lund Observatory Tables for the Conversion of Equatorial Co-ordinates into Galactic Co-ordinates based on the Galactic Pole R.A. $12^h\ 40^m$; Dec. $+28°$ (1900.0). Computed under the direction of and provided with an Introduction by John Ohlsson. Pp. xxiii+147. (Lund.)

Meddelande från Lunds Astronomiska Observatorium. Ser. 2, Nr. 65: Second List of Stars with Large Proper-Motions in the Ag-Zone of Lund. By W. Gyllenberg. Pp. 19. 1.50 kr. Ser. 2, Nr. 66: Positions of 241 Stars, mainly Long-period and Irregular Variables, and Proper Motions for 117 of these Stars. By Frida Palmér. Pp. 63. 5.50 kr. (Lund.)

Tätigkeitsbericht der Sternwarte Lund für das Berichtsjahr 1931. Von Knut Lundmark. Pp. 11. (Lund.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 66: The Influence of Growth Stage and Frequency of Cutting on the Yield and Composition of a Perennial Grass, *Phalaris tuberosa*. By Dr. A. E. V. Richardson, H. E. Trumble and R. E. Shapter. Pp. 35. Pamphlet No. 32: The Chemistry of Australian Timbers. Part 2: The Chemical Composition of the Woods of the Ironbark Group. By W. E. Cohen, A. L. Baldock and A. G. Charles. Pp. 36. (Melbourne: H. J. Green.)

Indian Journal of Physics, Vol. 7, Part 4, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 16, Part 4. Conducted by Sir C. V. Raman. Pp. 285-351. (Calcutta.) 1.8 rupees; 2*s*.

Paleontologiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 2, Stuk 3: Die Stamlyn van die Sebras. Deur Dr. Ir. E. C. N. Van Hoepen. Pp. 23-37. (Bloemfontein.)

Annale van die (Annals of the) Transvaal Museum. Vol. 15, Part 1, 1st October. Pp. 122. (Pretoria: Government Printer.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 383: On the Singlet Principal Series of Mercury. By Yoshio Ishida and Shigeru Hiyama. Pp. 79-82+plates 13-15. 15 sen. Nos. 384-392: The Effect of Humidity on Supersonic Velocity in Air, by Masao Kinoshita and Chihiro Ishii; The Most Probable Values of e, e/m and h, by Kamekichi Shiba; Carotin in Mango Fruit (*Mangifera indica* Lin.), by Ryo Yamamoto, Yasuyosi Osima and Teruo Goma; On the Carotinoids in Fresh Tea-Leaf and Fermented Tea, by Ryo Yamamoto and Tosiro Muraoka; On the Organic Acids in the Fruits of Ceylon Olive (*Elæocarpus serratus* Lin.), by Ryo Yamamoto, Yasuyosi Osima and Teruo Goma; On the Red Colouring Matter of *Hibiscus babdariffa* L. (a new Glycoside Hibiscin), by Ryo Yamamoto and Yasuyosi Osima; The Carotin in the Fruit of *Areca catechu* Lin., by Ryo Yamamoto and Tosiro Muraoka; On the Size of Fog Droplets, by Masao Kinoshita and Kiyoshi Uchiyama; The Effect of Superimposed Alternating Magnetic Fields upon Dielectric Loss-Angles, by Yoshitaro Fujikawa and Jiro Kitasato. Pp. 83-162. 60 sen. (Tokyo: Iwanami Shoten.)

U.S. Department of the Interior: Office of Education. Bulletin, 1931, No. 20: Biennial Survey of Education in the United States, 1928-1930. Chapter 1: Statistical Summary of Education, 1929-30. By Emery M. Foster. Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents.

Palæontologia Sinica. Series C, Vol. 7, Fascicle 3: On the Fossil Vertebrate Remains from Localities 2, 7 and 8 at Choukoutien. By C. C. Young. Pp. iv+24+1 plate. (Peiping: Geological Survey of China.)

Field Museum of Natural History. Zoological Series, Vol. 18, No. 11: Birds of Western China obtained by the Kelley-Roosevelts Expedition. By Outram Bangs. (Publication 314.) Pp. 341-379. (Chicago.) 25 cents.

Proceedings of the United States National Museum. Vol. 81, Art. 13: The Trematode Parasites of Marine Mammals. By Emmett W. Price. (No. 2936.) Pp. 68+12 plates. (Washington, D.C.: Government Printing Office.)

Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Director of Agriculture for 1931. By Dr. W. Youngman. Pp. D163. (Colombo: Government Record Office.) 1.65 rupees.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 85: Thomson Effect of Crystalline Substances. By Yositosi Endô. Pp. 115-149. 0.40 yen. No. 86: On the Balancing of Two-stroke 12-Cylinder Engines. By Fujio Nakanishi. Pp. 151-159. 0.15 yen. No. 87: A New High-Speed Indicator for Internal Combustion Engines. By Fujio Nakanishi, Masaharu Itô and Kikuo Kitamura. Pp. 161-177. 0.25 yen. (Tôkyô: Koseikai Publishing House.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 3, Part 5: The Seven Islands of Izu Province, a Volcanic Chain. By Dr. Bundjiro Kotô. Pp. 205-219+4 plates. 0.70 yen. Vol. 3, Part 6: Tertiary Mollusca from the Coalfield of Uryu, Ishikari. By Matajiro Yokoyama. Pp. 221-247+4 plates. 0.70 yen. Section 3: Botany. Vol. 2, Part 6: Morphological Studies of *Anemonopsis*, *Actæa* and *Cimicifuga*. By Masao Kumazawa. Pp. 413-454. 0.70 yen. Vol. 2, Part 7: On the Structure and Affinities of some Cretaceous Plants from Hokkaido, Second Contribution. By Yudsuru Ogwa. Pp. 455-483+plates 22-24. 0.70 yen. Vol. 4, Part 1: On the Systematic Importance of Spodograms in the Leaves of the Japanese Bambusaceae. By Kiichi Ohki. Pp. 130. 1.70 yen. (Tokyo: Maruzen Co., Ltd.)

Memoirs of the College of Science, Kyoto Imperial University. Series B, Vol. 8, No. 1. Pp. 80. (Tokyo and Kyoto: Maruzen Co., Ltd.)

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1929 under the direction of Dr. S. K. Banerji. Pp. iv+138+5 plates. (Calcutta: Government of India Central Publication Branch.) 12.2 rupees; 19*s*. 6*d*.

Tanganyika Territory: Geological Survey. Annual Report, 1931. By Dr. E. O. Teale. Pp. ii+51. (Dodoma.) 2*s*. 6*d*.

SATURDAY, NOVEMBER 26, 1932

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The Scientific Outlook

It might have been expected that two such addresses as those delivered by Sir Alfred Ewing and Prof. Miles Walker at the York meeting of the British Association would have provoked a storm of criticism. Much of the criticism has, however, been directed at the details of the scheme proposed by Prof. Miles Walker, and some of the critics have assumed that his address advocated the participation in government of the engineer as distinct from other scientific workers, or indeed from those possessing a scientific outlook or the capacity to assess technical and scientific factors. Few of the critics have revealed any appreciation of the difficulties with which mass production confronts our civilisation or the moral weakness of man as compared with his tremendous command over natural forces.

The fact that both addresses were delivered by engineers has made it easier for prejudice to obscure the real issues by representing the addresses as sectarian clamourings for greater power. The fundamental challenge which they issue to the present order was ignored and it was left for Prof. J. L. Myres, at the Oxford meeting of the Association of Special Libraries and Information Bureaux, in an address on "Science and the Humanities", to direct attention to this challenge. Prof. Miles Walker's address does not so much outline an experiment in sociology, an attempt to relate knowledge and power more effectively and to eliminate prejudice, as offer a challenge to the general outlook of to-day, the poverty of which is one of our most serious troubles. Men have assumed too easily that the present depression will be ended by the old methods and that a return to prosperity will come without special effort.

Two things are involved in any such effort, on both of which Prof. Miles Walker touches: accurate knowledge of the changes which are taking place in our civilisation as a result of the application of scientific discoveries, and particularly of the consequences of power production and of the increased means of communication, whether in the sense of transport or of intelligence such as in broadcasting; and secondly, the training which must now be given to people in this age to render them competent to live.

It is at this point that we reach the essential challenge to modern politics, economics and education implicit in the last part of Sir Alfred Ewing's address. What society must inevitably

consider is the relative value of science and the humanities both in the organisation and development of the world order and in the preparation of the individual members to enjoy the privileges and discharge the responsibilities inherent in membership of a society based on scientific achievements. The criticism of the scientific training given by our existing educational system, which came from Prof. Miles Walker, is supported by similar criticism from many other quarters; in neither education, politics nor economics is it wise to assume that our present institutions will stand the test without radical transformation.

The relative contribution of science and the humanities at this juncture of national or world affairs cannot be determined merely by reference to discussions on this subject in the past. The question must be examined in relation to the factors of to-day, and Prof. Myres in his analysis wisely refers us back to the main purposes of any system of education. One main object of education must be to place at the disposal of the next generation the experience accumulated in the past of what takes place around us and of the way in which people react to their environment, leaving it to the coming generation to make what use it chooses of such experience and to develop its own interpretation. This is, of course, the attitude which in the past scientific workers have adopted towards their own discoveries. They have been content for others to make of them what use they would and have been comparatively indifferent to the far-reaching consequences which for good or ill have sometimes flowed from their application. It is this indifference, or the divorce of knowledge from life, that has marred much of our teaching of science and created a prejudice against learning.

The economic consequences of the increased productive powers conferred by mechanical science, the prostitution of scientific knowledge to destructive purposes in armaments, the misuse or abuse of the advantages of modern transport, radio, the cinema for anti-social purposes, and the immense powers for mischief which the application of modern scientific discoveries puts in the hands of careless or vicious individuals in themselves have brought many to realise that neither science nor society can continue to be unconcerned with the social and moral consequences of scientific research. It is, however, less frequently perceived that brilliant progress in scientific research and discovery can proceed side by side with the full development of moral qualities and æsthetic or artistic tastes, and that in fact in the absence of such an environment scientific advance is impeded.

The pursuit of this main objective in education accordingly leads us to realise how closely related are scientific achievement and cultural or moral standards. Prof. Myres pointed out, however, how much more closely they are related in the second main objective of education, the training of the growing generation in the use of knowledge. This involves the development of human qualities and individualism, the teaching of self-consciousness and of control of oneself, individually and in relation to others. This aspect of knowledge or information is often overlooked, and results in the rigid distinction between the natural sciences and the humanities which has worked so much mischief in education. The human sciences—human biology, psychology, and statistical economics—form a coherent system and are a fitting subject of scientific study, while moral, political, economic and æsthetic subjects have a geographical as well as a historical aspect or distribution. It is only when the geographical distribution is taken into account that the humanities come into a right relation with life. Individuals and societies alike have a geography and a historical geography as well as a biography, and this inevitably wears thin the distinction between science and the humanities.

Moreover, the distinction between pure and applied science rests on essentially the same factors. So long as they are concerned with problems which have a systematic solution independent of local or temporary conditions, even agriculture and engineering are in effect pure sciences. It is only when they are taking account of local or temporal factors that they become 'applied', and perhaps one reason why so much is at present expected from the engineer is that the liberal traditions of the engineering profession make full allowance for distribution considerations. Accordingly, it should be obvious that a systematic science can only be one factor in education for life. It stands apart from the central mass of knowledge and needs supplementing. Similarly a so-called human science has little value when it becomes systematised and ceases to reveal something significant about man.

We may humanise the teaching of a systematic science by devoting more attention to its historical growth and regional applications, as is seen in the growing use of anthropology in the administration

and education of the backward races. We may clarify and intensify the teaching of the humanities by a firmer distinction between their systematic aspect and those historical and regional reconstructions which alone can set the present civilisation in an intelligible perspective. In so doing we should undoubtedly increase the effectiveness of the training we give as a preparation for life, but such teaching and training demand *a priori* an adequate vision on the part of those giving it. They must themselves have put their minds accurately and intelligently on the facts and situations they have to face.

It is the general absence of an adequate scientific outlook with all that it connotes—the willingness to accept change, the capacity to explore new situations, and to develop appropriate methods undeterred by prejudice or preconceived ideas—that is our gravest danger to-day. To that outlook there must be joined those moral qualities, sincerity of purpose, loyalty to truth, patience, courage, humility, unselfishness and the capacity to work with others, of which neither the philosopher nor the scientific worker has a monopoly and which both have demonstrated can be consistent with the exercise of the greatest intellectual gifts.

The clash between science and the humanities or the classics is long since out of place. The noblest resources of both are needed in the task before us if true are to be sifted from false values. Means must be found of making accurate knowledge of the facts of the universe eloquent and understood of all, and equally the moral consciousness of mankind must be roused to use his knowledge to great purposes. It is only as men are willing to face the full facts of the situation, to develop new methods where they may be called for, to renounce on occasion deeply embedded habits or even ways of thought and take up the challenge of adventure which scientific advance flings down to them, that we can hope to emerge from our present difficulties, and handle successfully the many problems presented by an age of mechanism with its concomitant leisure.

For the planning and national planning thus involved for the full exploration and interpretation of the phenomena of social life, scientific outlook and method must be harmoniously linked with a vision of humanity, a sense of values, of order and of beauty which mankind has learnt to find in the individual experience or biography recorded in the humanities in great literature and art.

The Origin of Mammals

The Mammal-Like Reptiles of South Africa: and the Origin of Mammals. By Dr. Robert Broom. (Issued under the auspices of the Carnegie Corporation of New York, and the Research Board, Union of South Africa.) Pp. xvi+376. (London: H. F. and G. Witherby, 1932.) 25*s*. net.

FOR many years the fossil reptiles found in the Karroo rocks of South Africa have excited great interest because they seem to include the ancestors of mammals, or at least show how some of the early reptiles may have passed into mammals. They date back to the Permian and Triassic periods, when mammals and birds must have had their beginning; and many of them are in so remarkable a state of preservation as whole skeletons that they are most satisfactory for study. Nearly all, however, are described in small scattered papers, and some are so strange that they have been interpreted in different ways at different times by various authors, so that it is not easy to obtain a good idea of the interesting phase of reptilian evolution which they represent. Dr. Broom has thus done good service to science by preparing an authoritative summary of our present knowledge of the subject, to which he himself has contributed the greater share during the past thirty years. With the aid of a grant from the Carnegie Trust he has published a handsome volume, which will be eagerly studied by all who are interested in current biological problems.

The Karroo rocks seem to have been formed at the mouth of a great river which spread its mud over what is now South Africa for many millions of years. There were desert regions around, and most of the sandstones originated from masses of blown sand. The area was sinking, so that an immense thickness of deposits accumulated, and great changes in the reptile life are observable in the successive layers or zones. Dr. Broom briefly enumerates these changes, and shows how some of the latest Karroo reptiles are the most mammal-like, while some of the earliest are most similar to the amphibians which were presumably their ancestors. There is, however, scarcely any trace of these ancestors in South Africa, for the lowest Karroo rocks, so far as known, rarely contain remains of vertebrate animals.

The greater part of Dr. Broom's book naturally consists of a technical systematic account of the various genera and species, which are arranged in

the several large divisions that he recognises. In each case a reference is given to the original description, when the species has been described before; and when there are synonyms or expressed differences of opinion, these are always discussed. There are also some important corrections of localities assigned to certain fossils in the writings of Owen and other pioneers. The descriptions and discussions are well illustrated by a series of clear diagrams drawn by Dr. Broom himself. There are, however, no illustrations of the actual fossils, to show their state of preservation and permit any judgment as to the reliability of the conclusions based on them. Dr. Broom, indeed, considers that such illustrations are not needed in a scientific treatise, and commends the restored figures of fossils published by Traquair and Marsh; but he omits to mention that Traquair's restorations were usually accompanied by drawings of the specimens on which they were based, while Marsh's restorations are considered so unsatisfactory by later American palæontologists that they have begun to publish figures of the original specimens for reference. He even approves a "restored skull drawn from two or three specimens", without giving any account of the nature of the fragments; thus producing composite portraits, so to speak, like those in certain early works on fossil invertebrates which have caused so much confusion in stratigraphical geology, and are now being remedied by the publication of photographs of the original fossils when these can be traced. This is our only serious criticism of the book, but it bears some marks of hasty compilation, and we would add that the descriptions of the species (especially new species) would have been more useful if the locality and horizon had always been stated. A table of distribution would have been a desirable addition.

Dr. Broom summarises his results in a most interesting chapter on the origin of mammals. He discusses the range and the relationships of the several groups, and among other curious facts notes the long range in time of the Anomodonts, which had a horny beak replacing teeth. Pointing also to the Chelonians and the birds, he remarks that the horny beak is one of the "most successful adaptations ever accomplished". He adds that "all the steps by which the mammals have arisen from the reptiles seem to be connected with change of habit and change of diet, comparatively slow moving forms have given place to others with greater and greater powers of active movement". Small omnivorous and carnivorous animals have the best chance of advancement, and the little Ictidosaurians of the Upper Karroo seem to be as nearly as possible mammals.

In a concluding chapter Dr. Broom gives a sympathetic account of the discoverers and chief collectors of the Karroo fossil reptiles, all of them amateurs well occupied in other vocations. Andrew Geddes Bain, the pioneer in South African geology, was a civil engineer. He was followed by his son and J. M. Orpen, and some medical practitioners, a clergyman, a farmer, a postmaster, a gardener, and a blacksmith. Dr. Broom himself, during most of his career in South Africa, has been busily engaged in the medical profession, and could only devote his leisure to scientific research. He is to be congratulated on his remarkable success; and his progress should be stimulated by the admirable review of past achievement which he has just completed.

A. S. W.

Magical Arts and Beliefs in Europe

(1) *Witchcraft, Magic and Alchemy.* By Grillot de Givry. Translated by J. Courtenay Locke. Pp. 395 + 10 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1931.) 42*s*. net.

(2) *The Story of the Devil.* By Arturo Graf. Translated from the Italian by Edward Noble Stone; with Notes by the Translator. Pp. xiv + 296. (London: Macmillan and Co., Ltd., 1931.) 15*s*. net.

(1) EVEN if the claim that this book is unique as an iconography of witchcraft and the occult were not justified, it would still be noteworthy in any collection of works dealing with the subject of magic for the number and character of its illustrations. Three hundred and fifty figures in the text, and ten coloured plates, reproduced from carvings, drawings, paintings, prints, and manuscript or book illustrations, provide a panorama of the magical arts and beliefs in Europe from the Middle Ages to the beginning of the nineteenth century. Not only do these illustrations cover such obvious topics as the devil and his angels, the sorcerer and the witch, the alchemist, the astrologer, early users of the divining rod, and searchers after the philosopher's stone; but here are also divination and fortune telling—whether by the hand, the lines and form of the face, clairvoyance, or the cards and other material means—the tarot, the cabbala, and the talisman. The

pictures of the laboratories and apparatus of the alchemist and 'puffer' in various periods are of great interest to the historian of the development of scientific investigation.

The originals of some of the prints and other illustrations are of extreme rarity: many are in the possession of the author and other collectors; while those which are open to public inspection could be consulted only with much expenditure of time and money. Now brought together within the covers of one book and provided with an excellent running commentary, they are made accessible to every student, and their value enhanced enormously.

Not a great deal of the material collected here is connected directly with folk-lore, that is, with the belief of the folk in the stricter sense. In the early woodcuts from various sources a wizard crosses the sea by means of a spell, witches raise storms or sell winds bound by a knotted cord to sailors, and a witch draws milk from the handle of an axe stuck in a post. In passing, it may be suggested that it would be in accordance with popular belief if a sorry cow in the background were the source of the milk, rather than its condition the cause of a dearth which the witch is being asked to remedy, as the author believes.

The greater proportion of the illustrations which deal with the witch and related conceptions, however, are in what may be called the 'theological' rather than the popular tradition. They range from the Last Judgment to the Witches' Sabbath. It is not without significance that the artists' representations of the Sabbath, for example, agree down to minute detail with the 'official' description of orthodox writers. It is only in the eighteenth century, when the persecution of witches had died down, that discrepancies and fantastic details supplied by the artist's imagination begin to appear. In Spain, however, where the tradition perhaps, was stronger, Goya even at the beginning of the nineteenth century was able to maintain accuracy in detail, with startling and horrific effect. It is interesting to find that in Germany, so late as the middle of the eighteenth century, cartographers, in mapping the Hartz district, still kept up the tradition of showing the Brocken out of all proportion, and of representing on the map crowds of witches proceeding to the great celebration of the Sabbath on broomsticks and on foot.

Although an examination of those illustrations here which relate to witchcraft and attendant beliefs, when taken as a whole and in logical sequence, tends to confirm the view that the accounts of the organisation of the witches and their ceremonial, as we find them in the witchcraft persecution, were the product partly of theology, partly of imagination stimulated to excess by panic, hysteria, and psychopathic aberration, there is no doubt that they embody much that was taken from authentic popular beliefs, for which parallels can be found in the magic of primitive peoples. Sometimes these illustrations serve to emphasise such points in a way that the literature fails to do. It is interesting to note that in representations of the witches' and sorcerers' dances are cases, clearly, of the phenomena of possession which we know from other sources was rampant at times in medieval Europe. It is also made very apparent that witchcraft was closely allied to an animal cult and the werewolf belief. In a Teniers' print the witch takes on animal form as she flies up the chimney.

(2) That the devil was in the main a creation of the theologian, or perhaps it would be more correct to say that his character, attributes, and achievements were embroidered on a non-Christian concept by theological dogma, is supported by the material which has been brought together in Arturo Graf's book. The original, of which the volume now under notice is a translation, appeared so long ago as 1889. Had it been written to-day, or even a decade later than it was, the author's orientation might have been slightly different. Possibly he would have laid more emphasis upon the incorporation into Christianity of elements from the religions of the Mediterranean and the Near East, as well as on popular belief. This in no way detracts from the excellence of his work so far as it goes: but his picture would be by that the more complete in detail. That this would have modified his conception of the devil in any essential is improbable. The trend of his thought is indicated by the fact that he believed, at the time of writing, the devil was dead.

Graf's purpose was neither analytical nor controversial. He set out to give a plain descriptive account of the belief in the devil, mainly as it existed in medieval times. The belief, he held, originated in the conflict between the powers of good and evil which was the predominant element in Zoroastrianism and had been adopted by Gnostics and Manichæans. By the time of the medieval theologians, the two kingdoms of Heaven and Hell had taken their stand over against one another in the contest for the domination of the world with all the trappings and organisation in court and camp of an earthly principality. The author describes in some detail the precision with which the exact number of devils forming Satan's

legions and their organisation was determined. The character and province of each of the Princes of Darkness was appraised with no less degree of accuracy.

In the result, the Church built up a picture of the devil and his followers which in practice, if not in theory, and in the belief of the average man, elevated him to a position of influence transcending that of God. When Graf describes the activities of the devil, his frauds and violent acts, his temptations, his loves and his offspring, he exhibits the devil as a constant obsession of everyday life. He goes on to suggest that in this perverted form of religious emotionalism, which had the devil and not the deity as its central object, is to be found the explanation of such obscene practices as were attributed to the Patarini and other heretical sects, and of the witches' Sabbaths with their elaborate inverted ceremonial. Graf allows this much of reality as the basis of the witch persecution: it might equally well have originated in the leading questions formulated by the perverted imagination of the Inquisitors. In either case, it would arise from a Christian theology rather than a paganism surviving as a living force in a folk-ritual, as some would have it.

The succubus and the incubus, the defeats of the devil, the ridiculous devil and the good devil, especially the last two named, prompt further discussion, especially in relation to early forms of spirit belief, the medieval sense of humour, and the cult of the obscene as a prophylactic; but space forbids. Enough has been said to indicate the excellences as well as the limitations of a fascinating book.

The translation is admirably done, and the notes by the translator are both scholarly and helpful.

Advanced Studies in Heat

A Text Book of Heat (including Kinetic Theory of Matter, Thermodynamics, Statistical Mechanics, and Theories of Thermal Ionisation). By Prof. M. N. Saha and B. N. Srivastava. Pp. xxv + 771. (Allahabad: The Indian Press, Ltd., 1931.) n.p.

A COMPARATIVE beginner in the study of physics automatically subscribes to the time-honoured convention, which the average textbook does little to dispel, of grouping the subdivisions of that branch of science under five or six rigid headings. Some utility may reasonably be claimed for such classification, even though the insidious evil of thinking in terms of 'water-tight compartments' may not be unconnected with so primary an attempt to sub-divide knowledge of natural phenomena. The revolution initiated early in the present century by the quantum theory has been so drastic, and has been followed up by a vast field of workers eager to explore the multiplicity of paths which it brought to light, with the result that an amazing accumulation of knowledge has resulted, with which the modern physicist and chemist is expected to cope.

The elimination of the artificial boundaries within the realms of physical science, and the definite progress being made along the lines of co-ordinating and unifying our views of the mechanism of natural phenomena are strikingly apparent from a study of this up-to-date and concise treatise on the work and its outcome resulting from the revolution to which attention has just been directed. The need for a good digest of modern heat theory must have been acutely felt by the majority of advanced students, and the publication of this textbook, one of the authors of which has made extensive contributions to important aspects of the subject, is all the more welcome at the present time, inasmuch as it comprises a most comprehensive survey, conceived and carried out on broad and generous lines, of information which could only otherwise be obtained by laborious reference to a large number of special treatises and original papers.

The ordering of the subject matter shows a slight departure from the conventional. The normal content of the 'intermediate' textbook is little in evidence, and introductory chapters on thermometry and calorimetry are followed by a detailed review of the kinetic theory of matter, equations of state, and change of state. A chapter is devoted to low temperature technique and the approach to the absolute zero, after which comes a condensed survey of thermal expansion and a more detailed survey of conduction with its relation to electrical conductivity. Heat engines are reviewed in historical sequence as an introduction to the laws of thermodynamics and entropy, thermodynamical functions, equilibria of physical and chemical systems, and thermodynamics of chemical equilibria, illustrated, amongst other reactions, by the Haber process.

The section on radiation contains a complete historical review of the subject, including the development of the quantum theory, with abridged deductions of such relations as the Rayleigh-Jeans,

and Wien's laws, and a fairly complete account of Planck's epoch-making researches. It is open to question how far much of the early theoretical work on radiation might have been omitted in favour of more detailed descriptions of general modern experimental methods and technique. The new quantum mechanics quite reasonably finds no mention in the book. The account of the quantum theory is naturally followed by a survey of the older well-known anomalies and difficulties to which it formed, in so striking a manner, the key. The concluding two chapters are devoted to the Nernst heat theorem, the Einstein-Bose-Fermi statistics, and the theory of thermal ionisation in relation to the state of matter at high temperatures; an important and welcome inclusion. Certain important general deductions and tabular data are collected in an appendix. Good name and subject indexes occupy respectively 7 and 23 pages, though even the latter failed under the test of a search for 'photon', discussed in the text.

The volume as a whole is undoubtedly one of the best advanced textbooks of heat, and much attendant physical chemistry, at the present time. As stated in the preface, it is based largely on lectures to B.Sc. (Hons.) and M.Sc. students. Copious footnote references are given to original papers and special bibliographic sources of information, which extend the utility of the book to specialists and research workers. The treatment throughout is largely theoretical, while the experimental side is distinctly condensed, although the diagrams are good and moderately numerous. The somewhat cheap-looking and poor style of printing, particularly of formulæ, along with minor typographical errors, could doubtless be rectified in a succeeding edition. N. M. B.

Short Reviews

Chemical Encyclopædia: a Digest of Chemistry and its Industrial Applications. By C. T. Kingzett. Fifth edition. Pp. viii + 1014. (London: Baillière, Tindall and Cox, 1932.) 40*s*. net.

THE issue of a fifth edition is presumptive evidence that a book has filled a need, and this is certainly the case with Kingzett's digest of chemistry. We have had it on our shelves for some little time, and have found frequent opportunity to test it in the daily round of affairs. On every occasion it has provided the requisite information, generally with a reference to where the particular point can be followed up with greater detail.

Chemistry is so integral a part of every science to-day and covers in itself so vast a range that it will be of advantage to every scientific worker, not alone the chemist, to have this book to consult. The information is just what is wanted; succinct, without being lengthy, details are given as to what a compound is and what it is used for. Electrons, elements, enzymes, effluents, eggs, enamels and emulsions, all receive appropriate and illuminating paragraphs. The work has been brought right up to date, and there is evidence of meticulous care on every page. The cross-references are very complete. A useful feature is the indexing of substances with proprietary names, such as carbosil, carboraffin, carboxide, with an indication of what they represent; in the past it has often been difficult to identify these.

Modern Chemistry: the Romance of Modern Chemical Discoveries. By Dr. Frederick Prescott. Pp. xiii + 370 + 39 plates. (London: Sampson Low, Marston and Co., Ltd., n.d.) 12*s*. 6*d*. net.

THE object of Dr. Prescott's book is stated in the preface to be that of providing an account of some of the more important and interesting discoveries of chemical science and of their applications which shall be suitable for readers who, although aware of the importance of the science in daily life, have neither the time nor the inclination for mastering the details of the subject.

The first part deals with the scope and development of chemistry, including a concise history of early chemistry which is not always in agreement with modern knowledge, and a sketch of modern views on the atomic theory which contains a few inaccuracies, as on p. 73 where the disintegration of atoms is said to have been accomplished by means of X-rays. On the whole, however, these sections are accurate and clearly written. The applications of electricity, metals and alloys, fuels and illuminants, nitrogen fixation (which the author still calls "the nitrogen problem" and encumbers with descriptions of obsolete processes), explosives, cellulose products, colour chemistry (which is dealt with in some detail, structural formulæ written in a curious and inconsistently used script, and technical expressions being employed), "harnessing micro-organisms", and "chemistry versus disease", are the remaining sections of the book. J. R. P.

The Dorado. By John W. Hills and G. H. Harrisson. Pp. vii + 190 + 22 plates. (London: Philip Allan and Co., Ltd., 1932.) 10*s*. 6*d*. net.

THE dorado or golden salmon is, as the authors tell us, not even a relative of the well-known aristocratic fish, but one of what they happily call the "rather bourgeois" family of the Characinidæ, particularly characteristic of the fresh waters of South America, where they occupy much the same place as the carp family do in the Old World. The dorado is "the great commoner" of this characinid clan; very like the salmon in general appearance,

and even in possessing, like it, pink and palatable flesh; it is more heavily built and shows itself a stronger fighter when hooked, though less resourceful. In size also it corresponds roughly with the salmon; the authors' best fish was forty-six pounds in weight, but monsters of a hundred pounds were heard of. Old-gold in colour, with red fins and tail-stripe, the dorado surpasses the true salmon in splendour; but apparently all four species of its genus, *Salminus*, share the name. The authors' adventures in pursuit of this golden quarry are well told and well illustrated, and notes on other fish and on the bird life encountered help to make up a very readable and instructive volume.

One Hundred Years in Yosemite: the Romantic Story of Early Human Affairs in the Central Sierra Nevada. By Carl Parcher Russell. Pp. xvi + 242 + 29 plates. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1932.) 20*s*. net.

THIS attractive volume has inside its covers a map of the Yosemite National Park and adjacent regions and its frontispiece is a fine photographic portrait of Maria Lebrado, the last of the original Yosemite Indians, who died, at an age of more than ninety years, only last year. Full details of the warlike and other relations of the local Indians and whites are given, and it is plain that though the Yosemites were a troublesome tribe, the behaviour of the more advanced race was often discreditable. Most lamentable was the murder by a white man, of Major James Savage, one of those remarkable personalities who are able to control and win the affections of members of more backward peoples. No portrait of him appears to be extant, but those of some other celebrities connected with the development of the region are included, and a chronology with sources and bibliography of the history of human events in the Yosemite adds value to an already comprehensive work.

A Textbook of Practical Astronomy: primarily for Engineering Students. By Prof. J. J. Nassau. (McGraw-Hill Astronomical Series.) Pp. x + 226. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 18*s*. net.

ALTHOUGH primarily intended for students in civil engineering, this book is admirably adapted for a larger class of readers. A book on practical astronomy must necessarily take a lot of the theoretical arguments for granted, but even so, the author has succeeded in incorporating a sufficiently adequate amount of theoretical matter.

The principal instruments described are the theodolite, sextant, and zenith telescope, and the practical problems discussed concern the determination of latitude, longitude, azimuth and time. The methods of reducing observations are carefully described and illustrated by numerous examples. A feature of the book is the excellent series of diagrams. The only weak part is the first chapter, which is rather sketchily written (there we read, for example, that planets are opaque *spheres*). The book can be warmly recommended as an introduction to elementary practical astronomy.

The Elements of Astronomy. By Dr. D. N. Mallik. Second edition, revised. Pp. iii + 234. (Cambridge: At the University Press, 1932.) 14*s*. net.

THIS book treats of the usual subjects of elementary astronomy and, on the whole, it presents a satisfactory introduction for readers whose mathematical attainments are slight. Unfortunately, some parts of the book savour too much of a nineteenth century atmosphere. For example, the method of measuring the solar parallax by means of transits of Venus is fully described but there is no reference to the present direct practical method associated with observations of Eros; an example on 'time' has reference to an observation made in 1865 and the author appears to be unaware of the far-reaching alterations made in the almanacs in 1925, for he states that the Equation of Time is given in the *Nautical Almanac* for Greenwich Mean Noon. A second edition ought to have embodied the latest changes in astronomical practice and methods. The book is illustrated with numerous well-drawn diagrams (No. 34 is upside down). An interesting feature is the historical introduction with its background of ancient Hindu and Chinese astronomy.

Walter Leaf, 1852–1927: some Chapters of Autobiography. With a Memoir by Charlotte M. Leaf. Pp. x + 338 + 8 plates. (London: John Murray, 1932.) 10*s*. 6*d*. net.

CLASSICAL distinction, authority in the banking world, and social services, provide the threads of interest. Incidentally, we learn that Leaf's entry to Harrow School (1866) coincided with the appointment of the first science master, George Griffith. Again, the "new game of lawn tennis" was played at Cambridge about 1873. The court was the grass between the library of Trinity and the river. A badminton net, toy racquets, and parti-coloured indiarubber balls were obtained at the toy shops—the earliest apparatus used in the early days of a world game.

A Pocket Atlas and Text-Book of the Fundus Oculi. By Dr. G. Lindsay Johnson. Second edition, revised and enlarged. Pp. ix + 215 + 28 plates. (London: Adlard and Son, Ltd., 1931.) 12*s*. 6*d*. net.

THE revised and enlarged edition of this eminently useful guide to the uses of the ophthalmoscope will be welcomed by medical students and young practitioners. It is illustrated by a large series of Mr. Arthur Head's beautiful coloured drawings of the fundus, and the text is clear and easily understood.

Entomological Research in the Marquesas Islands

By Dr. HUGH SCOTT

THE Marquesas are the first islands chosen for intensive study by the Pacific Entomological Survey, which is being conducted jointly by the Bernice P. Bishop Museum, Honolulu, the Hawaiian Sugar Planters' Association, and other bodies. A preliminary general account of results by E. P. Mumford, director of the Survey, and A. M. Adamson, entitled "Entomological Researches in the Marquesas Islands", was prepared for the fifth International Congress of Entomology, in Paris in July 1932, and a few typewritten copies have been distributed.

Field-work was carried on by these two writers and others during the three years, 1929–31. Collections were formed of all terrestrial animals except birds (which were already fairly well known), all fresh-water animals, and plants (the last on account of their association with the insect fauna). Records were made of geographical, meteorological and other observations. Previous entomological work, the most important of which is based on the collections made by the *St. George* expedition, is being taken into consideration. The publication by the Bernice P. Bishop Museum of an extensive series of systematic reports has been begun, and an introduction is being prepared by Messrs. Mumford and Adamson.

The Marquesas are among the most isolated islands in the world, and are actually farther from continental land than any other comparable archipelago. Situated in 7°–11° S. lat. and 138°–141° W. long., they extend from north-west to south-east (the same direction as the Hawaiian and other Pacific groups) over some 230 miles. Their total area is about 500 square miles (that is, roughly one-fourteenth that of the Hawaiian Islands). All are high volcanic islands, almost entirely devoid of fringing coral reefs. The six larger islands reach an altitude of 3000–4000 ft.

Since the advent of Europeans, great changes have taken place, and are still rapidly happening, in the endemic flora and fauna. The familiar melancholy tale has to be told. Deforestation and denudation, for which sheep and other domestic animals are largely responsible, are far advanced. In the lower islands, the very interesting insect fauna seems doomed to extinction. In the higher islands, deforestation has affected much less the cloud zone above 2000 ft., where the moisture of the trade winds is precipitated as a heavy rainfall. But, even at these altitudes, the leeward slopes are relatively dry, and semi-arid *terres désertes*, denuded by grazing animals, occur. Moreover, the high forests are being invaded by a recently imported grass (*Paspalum conjugatum*), and a now cosmopolitan marauding ant, *Pheidole megacephala*, is an active agent of destruction.

The insect fauna has all the characters associated with isolated oceanic islands, *inter alia*, predominance of small size, dull colouring and obscure habitat; absence of many families and super-families, and of some entire orders; and disproportionate development of a few genera. Aquatic groups of insects and other fresh-water animals (as well as fresh-water plants) are poorly represented.

Groups entirely absent comprise the orders Plecoptera, Trichoptera, Ephemeroptera and Mecoptera (the first three of which are aquatic in their early stages); all the aquatic Hemiptera-Heteroptera constituting the sub-order Cryptocerata; among Hemiptera-Homoptera, the Cicadidæ, Cercopidæ, Membracidæ, aphids, and many families of Fulgoroidea; most families of Neuroptera, many great families of Coleoptera (for example, the entire lamellicorn series), many families of Diptera; and, in Hymenoptera, the sub-order Symphyta (sawflies, etc.) and most families of aculeates.

The authors regard these gaps in the fauna as strong evidence against the existence in past ages of extensive land areas in the Pacific. On the whole, this conclusion is probably right, but it may be pointed out that some of these groups are also absent from the faunas of islands not of volcanic and purely oceanic origin. Plecoptera, Mecoptera and Hymenoptera Symphyta are absent from the fauna of the Seychelles,* an ancient granitic archipelago, believed to be the remains of a much larger land, even if not of definitely continental origin. These groups are also, so far as is known, very poorly represented in Ceylon. Allowance must be made for their being apparently weakly developed in the tropics as a whole, both continents and islands, as compared with their much richer development in temperate latitudes.

Other features mentioned above, namely predominance of small size and dull colouring and weak representation of aquatic groups, are also characteristic of the fauna of the Seychelles. But disproportionately developed genera are much more numerous in the volcanic archipelagoes, and only of exceptional occurrence in the Seychelles.

Among the components of the Marquesan fauna one of the most interesting is the genus *Proterhinus* (Coleoptera, Rhynchophora). Originally discovered in the Hawaiian Islands, where more than 150 endemic species exist, it was made the sole genus of a new family. Afterwards a single species was found in Samoa and one in the Phœnix Islands, and two in the Marquesas must now be added. The genus most closely related to *Proterhinus* is *Aglycyderes*, of which one species in the Canary Islands and two in New Zealand are known†.

* See an abstract of "Summary and General Conclusions Regarding the Insect-Fauna of the Seychelles and Adjacent Islands", by Hugh Scott, (*Proc. Linn. Soc.*, Session 144, pp. 136–140, 1931–32).

† In several textbooks New Caledonia is included in the range of *Aglycyderes*, but I cannot trace any published description of a species in that country.

These two genera are now considered to form a single family. The distribution of *Proterhinus*, centred in Hawaii and with outlying species in other Pacific islands, is comprehensible, as is also the occurrence of related forms in New Zealand. But no explanation suggests itself for the existence of another relative in the Canaries, when no representative of the family has come to light in any other part of the world—even where the fauna has been intensively collected.

The degree of endemism is very high. Excluding wide-ranging forms, few or no species are common to the Marquesas and Hawaii or Samoa, the nearest high islands of which the fauna is well enough known for comparison. Among species the degree of endemism is probably lower than in Hawaii, but of the same order (that is, approaching 80 per cent); among genera it is much lower.

The proportion of endemic species restricted to a single island is apparently higher than in Samoa and of the same order as in Hawaii. For example, there is, as in many remote islands, a great development of endemic Curculionidæ, and, in the otiorrhynchine section, the number and diversity of species, each restricted to a single island, indicate that the archipelago is of considerable age. Like phenomena are noted among the Hemiptera-Homoptera, while, on the other hand, in one family of Hemiptera-Heteroptera a genus has developed into many closely allied endemic species, some of which range over several islands. Possibly these latter forms originated too recently to have diverged into separate species. It is too early to state whether any evidence is forthcoming of an increase in the habitable age of the islands from south-east to north-west, like that of which there is some indication in the Hawaiian archipelago.

Nor are generalisations as to the origin of the fauna yet possible; for, some groups of animals exhibit close relationships with the fauna of Hawaii, others with that of the south central Pacific islands lying to the south-west. Among the former are the Hemiptera-Homoptera, among the latter the Hemiptera-Heteroptera, and the endemic birds and land snails, which have little in common with those of Hawaii. Botanists have stressed the existence of important, though secondary, affinities between the Marquesan and Hawaiian floras.

Deductions bearing on past land connexions in the Pacific are also left until the fauna has been fully worked out. While the almost entire absence of coral reefs has been attributed to rapid subsidence, alternating elevation and subsidence have also been postulated. In either case, the number of species restricted to a single island indicates that the individual islands have been separated for a long period, if time be regarded in terms of what is needed for the formation of species.

The sections on association of endemic insects and plants, and the bearing of the investigation on agricultural and medical problems, cannot be discussed here. Enough has been written to show the nature of the questions discussed. The Survey may be congratulated on an excellent start.

Some Problems of Food Preservation

THE problems involved in the freezing, storage and transport of New Zealand lamb have recently been examined by the Food Investigation Board, in co-operation with the Empire Marketing Board, the New Zealand Department of Scientific and Industrial Research, the New Zealand Meat Producers' Board and the New Zealand Tonnage Committee representing the shipping lines trading between Great Britain and New Zealand.[1] The investigation involved an analysis of the physical conditions in the various storage chambers through which the meat passed and an examination of the effects of the environment on the quality and appearance of the carcases, as estimated from the loss of 'bloom'. Bloom is the freshly-killed appearance of the meat and is dependent upon the appearance of the superficial tissues, the exposed muscle, fat and connective tissue. It is affected by the following factors: the rate of cooling and freezing, which determines the opacity of the superficial connective tissue and, indirectly, the colour of the visible muscle; the amount of drying, excessive desiccation producing marked loss of colour in the muscle; the formation of methæmoglobin from hæmoglobin on prolonged storage, that conversion being hastened by sweating; and finally, excessive sweating, which also results in swelling of the connective tissue fibres with increase in their opacity.

When meat is frozen, the structure of the muscle is changed, so that on thawing it is not so resilient and there is a leakage of free fluid, usually referred to as 'drip'. Freezing probably denatures certain of the proteins so that they lose some of their power to hold water. At a temperature constantly below $-8°$ C. other changes, such as those due to autolysis, microbial growth or hydrolysis and oxidation of the fat, are only slight. It is therefore the alterations in the physical properties of the meat which are of the most importance. They are indicated by loss of weight as well as by loss of bloom.

The survey has shown that there is no need for radical alterations of technique, although improvements at each stage of the chain of treatment are possible. It has been found that bloom is affected not only by the immediate ante-mortem treatment of the sheep but also by such factors as breed, diet, age at killing, etc. Southdown crosses were found to have a good initial bloom and that was correlated with a higher concentration of hæmoglobin in the superficial muscle; older animals had a better bloom than younger of the same breed. Starvation prior to slaughter had

little effect on bloom but strenuous exercise was definitely deleterious, the superficial muscle being of a dark reddish-grey colour. The important conclusion is drawn that, within limits, carcases having the superior initial bloom will maintain this superiority throughout the subsequent chain of treatment.

After slaughter the carcases are cooled, preferably at a low temperature (12° C.), and in air near saturation point. Hanging for 10–12 hours should precede freezing. At this temperature the rate and extent of loss of weight during hanging are reduced, so that the superficial desiccation is also less. The rate of loss of weight on subsequent freezing is also lower with an adequate period of cooling.

Each chain in the passage of the meat from the freezing chambers in New Zealand to the cold stores in London was examined in detail. The advantages and disadvantages of the different systems of refrigeration are pointed out. The danger points are the transport from store to ship in New Zealand and from ship to store in Great Britain. Recommendations to minimise the delays at these points in the chain are given in the report: too long exposure of the carcases to a high temperature results in softening and sweating. It was found that the average loss of weight during cooling, freezing, 28 days storage in New Zealand, ocean transport and 28 days storage in Great Britain was 3·65 per cent in prime quality lambs and slightly greater in second quality carcases. The longer carcases are stored the greater is the loss of weight and, therefore, of bloom. Since loss of weight occurs to some extent even under the best conditions of storage, it appears necessary, to prevent any loss of weight or bloom, to cover the carcases with bags impermeable to aqueous vapour. The ideal bag, however, has still to be evolved.

Another problem of cold storage is the prevention of the yellowing of the abdominal fat in rabbits. Even when kept at a temperature of −10° to −12° C., the superficial fat, in addition to becoming rancid, acquires on its exposed surface a pronounced yellow colour, varying in tint from light yellow to dark orange. The discoloration extends to a depth of a few millimetres and in advanced stages the yellow fat is wax-like in nature and can generally be peeled off from the white fat beneath. The period between the killing of the rabbits in Australia and New Zealand and their marketing in Great Britain varies but is on the average 4–5 months. The longer the storage the more frequently is the yellowing found.

J. R. Vickery has recently carried out experiments on the nature and cause of this yellowing: the results obtained have indicated the measures which can be adopted to prevent it.[2] It was found that the rate of development of yellowing during storage in the frozen condition was dependent, within limits, upon the duration and temperature of storage in the pre-freezing period: thus storage for two days at atmospheric temperature prior to freezing enhanced the yellowing to a degree approximately equivalent to one month's storage at −5° C. The intensity and depth of penetration of the yellowness were proportional to the duration of storage in the frozen condition at a given temperature, and were greater the higher the temperature. At −10·5° C. the market value of the rabbits is affected within three to five months according to the nature of the pre-freezing treatment. At −18° C. yellowing is almost eliminated.

The yellow material accompanies the soaps on saponification of the fat and can be separated from the fatty acids by the use of ice-cold petroleum ether in which it is insoluble. It apparently has its origin in the oxidation of the linoleate glycerides under the influence of an oxidase present in the fatty tissue, the action of which is markedly accelerated by the presence of moisture and hæmoglobin. The pigment is probably an unsaturated ketonic compound.

The measures required to prevent yellowing are, therefore, the exclusion of oxygen and hæmoglobin, shortening of the time of storage and storage at a lower temperature. Air can be excluded from the abdominal fat by covering it with the muscle of the abdominal wall, hæmoglobin by thorough bleeding of the animals and cleaning the fat of all superficial blood: but a lower temperature of storage will still be necessary to prevent appreciable yellowing over periods of about six months.

Dr. Vickery also made a few observations on the development of rancidity in the fat of rabbits. It was found to develop on storage much more rapidly than is usually the case with other animals: its onset can be retarded by excluding air from the fat and storage at temperatures below −10·5° C., at which temperature rancidity may be expected in five months.

Further information on problems of food preservation can be obtained from the Index to the literature issued twice a year by the Low Temperature Research Station. The first number of vol. 4 contains a review of noteworthy developments during 1930-31,[3] to some of which brief reference may be made. Troy and Sharp have investigated the condition of lactose in dried milk, condensed milk and ice-cream. In dehydrated milk the lactose is present as an equilibrium mixture of non-crystalline α- and β-lactose; when milk is dried slowly below 50° C., lactose crystallises in the α-hydrate form. These facts are considered to explain the caking of milk powder and 'sandiness' in ice-cream. Parisi has shown that the velocity of crystallisation depends on the velocity of transformation between α- and β-lactose, and is influenced considerably by the hydrogen ion concentration of the solution. Lampitt and Bushill have shown that fat in milk dried by the roller-process can nearly all be removed by direct extraction with a solvent, while only a small proportion can be extracted in this way from spray-dried milk. The difference is attributed to the condition of the lactose; its crystallisation appears to result in 'freeing' of fat.

Slight hydrogenation of the fat has been found of value in the case of a number of foodstuffs: it prevents rancidity in tallow and lard; it stabilises the fat in butter without destroying its flavour; it bleaches palm oil without hardening it; and finally, in the case of cacao-butter, it prevents the 'blooming' of chocolates.

Morgan, Field and Nichols have found that the vitamin C content of prunes and apricots need not be reduced by dehydration or treatment with sulphur dioxide when the processes are carried out under properly controlled conditions. Clow and Marlatt state that the vitamin C content of tomatoes is the same whether ripening occurs in the field, in the greenhouse or is brought about artificially with the aid of ethylene. It has been shown by Kohman, Eddy and Zall that considerable loss of vitamin C and some loss of vitamin B occur in the canning of tomatoes in the presence of air: in steam this loss is not observed. Vitamin A is the most, and vitamin C the least stable. To preserve the vitamins it is essential to guard against oxidation during canning.

Morris and Bryan have found that the method of manufacture of steel may have a considerable influence on its rate of corrosion. In solutions of low acidity the main points of attack are the pits and seams of the tin, whilst in those of high acidity, the exposed portions of the tin are particularly liable to corrosion. It is recommended that citric acid be added to fruit of low acidity, that the sugar used be free from sulphur compounds (which have a considerable influence on the corrosion of tins) and that beet sugar be used, or agar added to inhibit corrosion.

[1] Department of Scientific and Industrial Research: Food Investigation. Special Report No. 41: The Freezing, Storage and Transport of New Zealand Lamb. By Dr. Ezer Griffiths, Dr. J. R. Vickery and N. E. Holmes. Pp. x+178+19 plates. 7s. 6d. net.

[2] Department of Scientific and Industrial Research: Food Investigation. Special Report No. 42: The Yellowing of the Abdominal Fat of Frozen Rabbits. By Dr. J. R. Vickery. Pp. iv+27. 6d. net.

[3] Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 4, No. 1, March. Compiled by Agnes Elisabeth Glennie. Pp. iv+135. 2s. 6d. net.

(London: H.M. Stationery Office, 1932.)

New Tank at the National Physical Laboratory

ON November 18, in the presence of a large gathering of naval architects, shipowners, shipbuilders, engineers and others, Mr. Stanley Baldwin, Lord President of the Council, opened the New Tank at the William Froude Laboratory, which forms a part of the National Physical Laboratory, Teddington. The New Tank has been built by the Government at a cost of £45,000 to meet the increased demand for model tests of ships' hulls, propellers and rudders, and like the Alfred Yarrow Tank, will be used in connexion with work for ships of the mercantile marine.

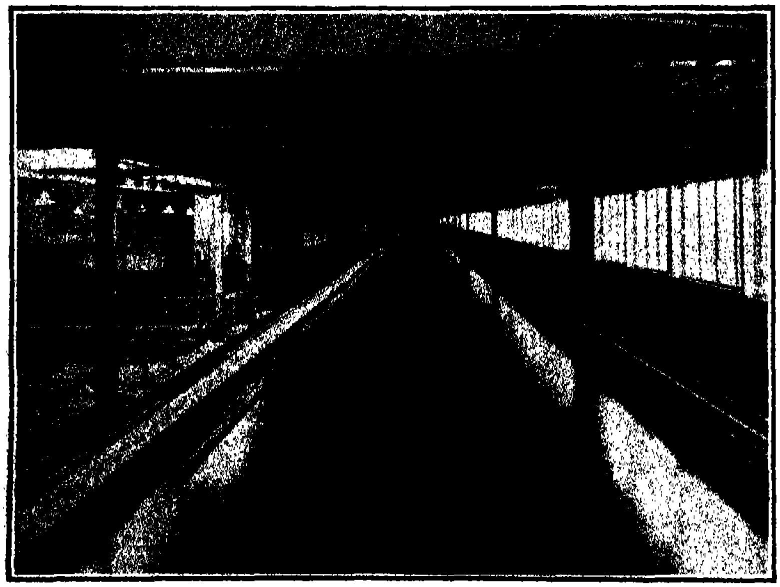

FIG. 1. The New Tank at the William Froude Laboratory

Referring to the work done in the Tank given to the Laboratory in 1910 by Sir Alfred Yarrow, Mr. Baldwin remarked that, in 1928–29 it had become impossible, though the whole staff of the Laboratory was working overtime, to comply with all the requests made for assistance by shipbuilding firms. During the years 1927–1930, 188 designs of hulls were tested in the Tank and it was possible to show how designs could be improved in no fewer than 114 cases. Among the results obtained, and adopted in the shipbuilding industry largely through comprehensive researches in the Yarrow Tank are the introduction of the 'cruiser stern' on ordinary mercantile vessels, the introduction of 'aerofoil' types of propellers, the change of rake now common in single-screw ships and the use of a central fin on this type of ship to control inflow into the propeller.

At the conclusion of his address, Mr. Baldwin went aboard the carriage of the New Tank and watched an experiment with the new equipment for testing the efficiency of propellers working in open water. Visitors present also had an opportunity of witnessing this and other demonstrations. A number of model hulls together with their recording apparatus were on exhibition, and with these were the drawings of the projected Propeller Tunnel, the cost of which (£5,000) is being defrayed by Sir James Lithgow.

The New Tank (Fig. 1) consists of a monolithic ferro-concrete water basin 678 ft. long over all and 20 ft. wide at the water surface. The depth

of water is 9 ft. for a distance of 446 ft. From this point the bottom slopes upwards gently for 36 ft. to the shallow end, 177 ft. long, where the depth of water is only 2 ft. The tank bottom and walls, the foundations of which are entirely separate from those of the building, were built in 20 ft. sections separated by 3 ft. gaps, which were filled in after the adjacent sections had set and hardened.

The carriage (Fig. 2) consists of a light frame structure of mild steel weighing approximately 10,000 lb. including its equipment. The rails on which it runs are 20½ ft. centre to centre. They were machined top and bottom before being fixed to the cast-iron longitudinal sleepers, and are exactly parallel with the surface of the water. The carriage is driven by two 56 h.p. electric motors at speeds of 2–30 ft. a second, and is brought to rest by slipper-brakes and a brake rail, operated by compressed air on the principle of the Westinghouse brake.

The control gear for the carriage is located at the side of the Tank, but should the current fail during the course of an experiment, the carriage is automatically brought to rest. In the central portion of the carriage there is an open well about 10 ft. by 4 ft. within which the testing apparatus is erected; just beneath this well the model floats in the water. In some cases the recording apparatus is placed in the models themselves, which are, of course, as usual, made of wax.

The history of experiments in Great Britain on the resistance of ships' models goes back to the pioneering work of Mark Beaufoy (1764–1827), David Napier (1790–1869), the Scotts of Greenock, the Halls of Aberdeen and others, but, as Elgar said in his Forrest Lecture in 1907: "The practical solution of the speed problem was effected by the late Mr. William Froude when he discovered the law of similitude or comparison which enables the resistance of a model, as ascertained by experiment, to be used for calculating the resistance of a model upon a different scale, or that of a full-sized ship of similar form."

Froude was born in Devonshire on November 28, 1810, and died at Simon's Town, South Africa, on May 4, 1879. After graduating at Oxford, he spent several years on railway construction and served under Brunel on the Bristol and Exeter Railway. In 1856, when Brunel was engaged with the building of the steamship *Great Eastern*, he asked Froude to investigate the motion of a ship among waves. From that inquiry Froude was led on to the study of problems akin to it, and through his experiments on towed models, the Admiralty, in spite of many adverse opinions, in 1870 constructed the historic experimental tank at Chelston Cross, Torquay, where Froude had settled. To-day there are more than a score of experimental tanks in existence and every one of them is a monument to the genius and work of Froude. The investigations carried out by Froude at Torquay, and later on at Haslar by his son, R. E. Froude (1846–1924) nearly all related

FIG. 2. The carriage of the New Tank

to warships. But just as the credit for the inauguration of the first official tank belongs to Froude, so the credit for the construction of the first tank by private enterprise belongs to William Denny (1847–1887), whose tragic death at forty years of age removed one of the foremost advocates of model experiments. In 1875 Denny sent Froude the lines of the S.S. *Merkara*, built at the Leven shipyard, Dumbarton, to enable him to make trials with a model for comparison with those already obtained with the ship herself. With permission of the Admiralty, this was carried out. Six years later, Denny began the construction of a tank at the Leven shipyard and this is now the oldest in existence devoted to mercantile work. On its facade it has borne for 49 years an inscription to Froude "the greatest of experimenters and investigators in hydrodynamics".

In his papers, his speeches and his letters, Denny did all within his power to convince his fellow shipbuilders of the utility of experimental tanks, and in 1884 wrote: "The truth is that of all the problems about a steamship the only one at the present moment incapable of being solved by *à priori* methods in extreme cases is that of speed and power. No ability and no training will enable even the most skilful naval architect to overcome the want of an experimental tank in coping with these questions."

Denny's was often a 'voice crying in the wilderness', but to-day there are few shipbuilders or shipowners who do not realise the value of the work done in such tanks as that opened by Mr. Baldwin, and none whose work is not influenced by it.

News and Views

Comptroller-General of Patents

AT the end of this month Sir William Jarratt, the Comptroller-General of Patents, Designs and Trade Marks, is retiring from the Patent Office after thirty-eight years service and six years of the comptrollership. He was educated at the Royal College of Science and Trinity College, Cambridge, where he obtained a first class in the Natural Science Tripos, and a first class in the Mathematical Tripos; he was called to the Bar of the Middle Temple in 1910. Sir William has done much to enhance the high reputation of this great Government department and has been prominently associated with important developments in patent law. In view of the growing world-wide importance of broadcasting, it will also be gratefully remembered by all authors and composers that it was mainly owing to Sir William Jarratt's intervention at the Copyright Conference in Rome 1928 that there was inserted in the Copyright Convention the article "11 bis" ensuring that "Authors of literary and artistic works shall enjoy the exclusive right of authorizing the communication of their works to the public by radiocommunication".

WHILE regretting that Sir William Jarratt will not be at the helm to steer the initial course of the new Patents and Designs Act, from which so much is expected and which owes so much to his inspiration and labours, we are glad to be able to state that he is not retiring entirely from public life, and that as the secretary of the Trade Marks, Patents, and Designs Federation Ltd., he will still be able to utilise his great knowledge and experience in the same field. This Federation is a body devoted to promoting and securing mutual support and co-operation amongst traders in the British Empire and foreign countries in all matters relating to the protection of trade marks, patents, designs and analogous rights, and the suppression of unfair trade competition. Sir William's successor in the Patent Office will be Dr. Mark Frank Lindley. Dr. Lindley is a doctor of laws of the University of London and a bachelor of science with distinction in physics; he is a barrister-at-law of the Middle Temple and author of a standard work on "The Acquisition and Government of Backward Territory in International Law". Dr. Lindley, like Sir William Jarratt, combines scientific with legal attainments and has followed him through the ranks of the examining staff of the Patent Office, and the assistant comptrollership, to the comptrollership. It is very satisfactory to scientific men and to all those connected with patents in Great Britain, to find that the practice has again been followed of appointing a man with scientific as well as legal training to the comptrollership of the Patent Office.

Sir Aldo Castellani

SIR ALDO CASTELLANI, who has been appointed to succeed the late Sir Ronald Ross as director-in-chief of the Ross Institute for Tropical Diseases, has rendered long and distinguished services to tropical medicine. He is lecturer on mycology and mycotic disease at the London School of Hygiene and Tropical Medicine, professor of tropical medicine at the State University of Louisiana and also at the Royal University of Rome, so that the direct influence of his knowledge and experience extends to several centres of teaching and research. In regard to the large field of his activities, and in the number of his contributions to medical literature, Sir Aldo has had a remarkable career. He graduated at the University of Florence and continued his studies at Bonn and the Lister Institute, went to Uganda in 1902 on the invitation of the Foreign Office to investigate sleeping sickness, then was appointed by the Secretary of State for the Colonies to the Ceylon Medical School and afterwards went to Naples for a time to occupy a chair in the Royal University, which he resigned in 1918 to join Sir Patrick Manson on the staff of the London School of Tropical Medicine. He thus possesses the highest qualifications to influence the work and promote the development of the Ross Institute.

Anniversary Meeting of the Royal Society

IT is perhaps worth while to recall that in 1832—one hundred years ago—the proceedings at the anniversary meeting of the Royal Society on St. Andrew's Day were conducted by H.R.H. the Duke of Sussex, as president of the Society. Two awards of the Copley medal were made, and Michael Faraday received one of them. The second recipient (by deputy) was Siméon Denis Poisson, the eminent French mathematician, in recognition of his treatise "Nouvelle Théorie de l'Action Capillaire". He had been elected a foreign member in 1818, along with Baron Prony, Arago, Nathaniel Bowditch, and the Abbé Haüy. Poisson was born in 1781, and he died at Paris in 1840. He was associated with the Ecole Polytechnique there for nearly forty years, and he will be remembered as a prolific and illuminating writer in mathematics, physics, and astronomy. It was on this occasion that an announcement was made that following the example of the Paris Academy of Sciences, the Royal Society would in future admit no paper into its *Transactions* which had not been previously submitted to the consideration of at least two members of the Council best acquainted with the subject under discussion. The Society's roll of membership at the period in question appears to have comprised 11 royal personages, 45 foreign members, and 692 home fellows, a total of 748. In accordance with custom and following the afternoon's proceedings the fellows of the Society dined together at the Crown and Anchor tavern, the Duke of Sussex being in the chair.

The Pacific Entomological Survey

ABOUT four years ago, certain institutions in the Hawaiian Islands, including the Bernice P. Bishop Museum, the University of Hawaii, the Sugar Planters' Association and the Pineapple Growers'

Association, organised the above-named Survey for the purpose of exploring thoroughly and studying the various island groups in the South Pacific, especially as regards their insect fauna. It was felt that this was a most necessary piece of work, seeing that the islands are being rapidly changed in regard to both fauna and flora, owing to the introduction of foreign plants and animals. It was also believed that the information gained would not only be most valuable from a scientific point of view but also extremely useful in a practical way. The first part of the work, the survey of the Marquesas Islands, has been done, and the detailed results are now being published by the Bernice P. Bishop Museum, Honolulu. Reference is made elsewhere in this issue (p. 797) to a preliminary general account of the work which has been prepared by Messrs. E. P. Mumford and A. M. Adamson. The finances for carrying on this work have been mainly advanced by the planters' associations. Within the last year, however, these organisations have suffered heavy losses which have made it impossible for them to bear the entire load of continuing the task. The Survey is, therefore, now making an effort to gain financial assistance from other quarters. In view of the splendid work which has already been done and of the very great need for continuing the Survey, it is hoped that this important piece of scientific and practical work will not have to be abandoned.

China and American Scientific Expeditions

BY courtesy of Dr. Chang Chi, chairman of the Chinese National Commission for the Preservation of Antiquities, we have received a copy of a letter dated September 24 which was addressed by the Commission to the American Museum of Natural History, New York, and covering a statement of its position in relation to the Central Asiatic Expedition of the Museum. It will be remembered that this expedition, which has been engaged in palæontological and archæological investigation in Inner Mongolia since 1922 under Dr. Roy Chapman Andrews, came to an end with the season of 1930, after which date no further permit was to be issued by the Chinese authorities. In the covering letter, Dr. Chang Chi, writing on behalf of the Commission, describes the interruption of the work of the expedition as "a most unfortunate breach in the cultural relations between China and the United States", and expresses his own regret that negotiations should have been broken off largely for personal reasons. At the same time, he reaffirms the readiness of the Commission "to promote scientific co-operation, if proposed on a fair basis". The covering letter also refers to an editorial article in the American-owned and edited *China Weekly Review* dated September 10, of which also we have received a copy. It consists largely of a personal attack on Dr. Andrews. This attack, or rather parts of it, the Commission regards as mainly irrelevant, nor does it endorse all the views expressed in the article, although it holds them significant as voicing the views of foreigners resident in China.

THE statement addressed by the Chinese Commission to the American Museum of Natural History, in addition to defining its attitude in the situation which has arisen from past activities of the American expedition and its members, declares that it is "ready to consider or submit to the proper higher authority or refer to the proper Chinese scientific institution any proposal of Sino-American co-operation for scientific exposition, despite any possible existing personal misunderstanding". It recites the terms of the agreement with Dr. Andrews of March, 1930, which, while safeguarding "Chinese interest and participation in this important scientific enterprise", assigned to the American Museum the bulk of the specimens obtained by the expedition, requiring only the return to China of representative duplicate fossils and two casts of unique specimens; and it claims to have voiced Chinese public opinion in 1928 when objecting to Dr. Andrews's activities in making archæological and palæontological investigations under cover of a hunting passport. The chief point in the memorandum, however, is the question of Dr. Andrews's recent attitude. It is stated that after repeated assurances from him that the expedition of 1930 would be final, a letter of application for a further permit for 1931 was received from him, and that without any interview with any member of the Commission. Further, in recent statements, for which he is presumed to be responsible, politics have been imported into a scientific question with the object of forcing a concession from the Chinese Government by political influence. Thus not only has the friendly co-operation with the American Museum of Natural History been interrupted, but also mutual misunderstanding has arisen between the American and Chinese peoples as to their respective attitudes.

International Commission on the Teaching of Mathematics

THIS body, constituted at the Congress of Mathematicians at Rome in 1908, had secured by 1914 the adherence of twenty-eight countries, and had evoked a large mass of valuable reports, of which those for the British Isles formed two volumes of Special Reports issued by the Board of Education in 1912. The decision to revive the dormant Commission was taken at Bologna in 1928, and this year has seen a resumption of activities, culminating in two sessions during the Congress of Mathematicians at Zurich. Prof. Hadamard of Paris succeeds Prof. D. E. Smith of New York, who has been president of the Commission since the death of Klein. The secretary is Prof. Fehr of Geneva. Though anxious to co-operate, the Board of Education is unable to play the same leading part as before the War, and the Council of the Mathematical Association has agreed to take over responsibility for the English Sub-Commission, at least until the Oslo Congress of 1936. There will again be three Commissioners, who will be assisted by special committees when reports are to be prepared. The commissioners appointed are Prof. E. H. Neville, who is on the Central Committee of the Commission, Sir Percy Nunn, and Dr. D. M. Wrinch. Reports will be published in the *Mathematical Gazette*.

Growth of Industrial Organisations

IN the second of the series of lectures on industrial affairs at the Imperial College of Science and Technology, Mr. Austin Hopkinson discussed the advantages of the small industrial organisation. In his submission, there is no evidence that increasing the size of an industrial concern leads normally to an increase in efficiency; indeed history shows that most very large organisations of this type have soon become unstable, and their collapse has led to the loss of immense amounts of capital. A distinction should be drawn, however, between natural and artificial expansion. A limit to natural expansion by internal growth or by absorption of less efficient competitors is set only by the managerial capacity of individuals, and the ideal size cannot be expressed therefore by any simple formula such as statisticians have attempted to devise. When for any reason, however, a concern is expanded artificially beyond this limit, the expedients resorted to in attempts to establish financial stability are likely to be contrary to the interests of the community as a whole. The fact that very large industrial organisations have exceptional power to influence politicians, trade union leaders and the Press, makes them a potential danger to democracy, and, although Great Britain is justly proud of the integrity of its political and industrial life, the possibilities of abuses in the region where they overlap are exceptional and cannot be disregarded.

Defects of Large Industrial Units

In Mr. Hopkinson's view, the dangerous influence of large industrial concerns is not offset by any contribution to the happiness and prosperity of the community. The existence of twenty separate firms engaged in a particular branch of industry means twenty sources of energy and enterprise: their amalgamation into one large unit eliminates nineteen of these sources. The only way in which a nation can preserve a standard of living higher than that of others is by continuing to produce goods of higher quality or goods which the others cannot produce at all: tariffs and embargoes are merely temporary expedients. It follows therefore that competition from countries with a lower standard of life can be met only by frequent changes in the nature, form or design of the goods produced; but it is just this condition which the large organisation finds most difficult to meet, owing to the inertia resulting from its very size. Again, very large firms have the power to stimulate markets by intensive advertising and hire-purchase schemes, but by thus compressing the purchasing power of a life-time into a few years, an unhealthy state of the market is induced, and a temporary advantage may be wiped out by a subsequent collapse. Finally, the estimate that 44 per cent of total factory production in Great Britain is in the hands of firms employing less than two hundred people indicates the important part which the small concerns play in industrial life: their contribution to the national exchequer is, no doubt, proportionately great.

Typhoon Season in the Far East

THE cyclone season of the northern tropics is this year being extended abnormally far into the autumn in the Far East as well as in the West Indies, for a typhoon visited the Loo-Choo Islands so late as November 14, and reached Tokyo late on the following night. The wind is reported to have blown with a speed of nearly a hundred miles an hour, and to have caused much material damage. The loss of life was fortunately small compared with that caused by the Cuban storm five days earlier. Although there seems to be no essential difference between the typhoon of the western part of the North Pacific and the West Indian hurricane, both being typical examples of the tropical cyclone, the typhoon season is not concentrated into a few summer and early autumn months to nearly the same extent as happens with the West Indian storms. There is, however, more similarity in the seasonal distribution of those storms that reach Japan. July, August and September are the dangerous months for Japan and the neighbouring seas; whereas the seas farther to the south are occasionally affected by a typhoon even in mid-winter and early spring, the occurrence of an intense developing typhoon near Japan so late as November is probably even rarer than a similar development in the West Indies. It is known that there is a connexion between the variations of the general circulation of the atmosphere and the regions of formation as well as the direction and speed of travel of tropical cyclones, but it is very doubtful whether the cause of the present abnormal prolongation of the cyclone season can be explained. It is points like this which may be cleared up when meteorologists possess a long series of daily synoptic charts for the northern hemisphere such as those now being prepared by the Deutsche Seewarte, Hamburg, described in NATURE of November 12, p. 748.

An Easily Portable Episcope

THE increasing appreciation of the value of episcopes in teaching has created a demand for an instrument, simple in construction, easy to handle, capable of being brought readily into the ordinary class room, and reasonably cheap. The Wigmore episcope which has been recently put on the market by Messrs. Newton and Co., 72, Wigmore Street, London, W.1, seems likely to meet this demand. It is light and, being provided with two carrying handles, can be easily carried from one room to another. It can be immediately installed and used in any room which has a projection screen and an electric lighting supply. In use, the episcope is simply placed upon the object to be shown on the screen; the externally mounted reversing mirror is tilted to bring the image to the required height; and the image is then brought into focus. Two 250-watt lamps are used for illuminating the field, which is 5 in. by 5 in.; but the map or drawing or book, a portion of which is to be projected, may be of any size. When the instrument is about 10 ft. from the screen, a well-illuminated picture 4 ft. square is

obtained with good definition over nearly the whole of the area. The working distance may be varied from 6 ft. to 24 ft., giving pictures from 2¼ ft. to 9 ft. square, with of course a diminution in intensity at the greater distances. The episcope, which costs £12 12*s*., complete with lamps, should prove particularly useful for illustrating lessons in classrooms or for demonstrations in small lecture theatres, where a very large picture is not required.

Cultivation of Living Tissue Cells

AT the Friday evening discourse at the Royal Institution on November 18, Dr. R. C. Canti exhibited films demonstrating the cultivation of living tissue cells. The films consist of moving photomicrographs of the living cells of animal tissues taken whilst they are growing outside the body. The individual pictures are taken at relatively long intervals but are projected on the screen at the usual speed of 16 pictures per second. This gives the effect of speeding up and approximately three weeks continuous photography is shortened into half an hour. The first film opened with the demonstration of a 'tissue culture'. This was followed by a picture of a fragment of periosteum of the chick embryo under low magnification which shows the outwandering of the cells from the central mass or explant. Higher magnification is then employed to demonstrate the structure of vegetative cells and the classical stages of cell division. The picture then changed from healthy to malignant tissue and showed the characteristic cells of a cancerous tumour of the rat known as Jensen's rat sarcoma. Dr. Canti's second reel was devoted to a demonstration of the contents of the cell by the method of dark-ground illumination, which reveals certain structures, for example, granules and mitochondria, invisible by the ordinary methods of trans-illumination. The third reel contained subjects of embryological interest, namely, the development of the rabbit ovum from the single cell up to the morula stage, the development of the young chick embryo from the primitive streak and the development of the bony femur from the cartilagenous rudiment in the six-day chick embryo. The apparatus for taking the photographs is a combination of the cinema camera, microscope and biological incubator, with a specially constructed automatic mechanism for making the exposures at the desired intervals.

Colour Films

THE paper read before the Royal Society of Arts on November 9 by Mr. T. Thorne Baker gave a useful account of new developments in colour cinematography. Compared with other inventions like radio-telephony, the aeroplane and sound films, the coming of photography in natural colours seems very slow. The coloured films which have been shown at many picture theatres during the last two or three years are nearly all two-colour pictures. The main drawback is that the colours obtained in these pictures are not absolutely natural. But now methods have been devised for obtaining three-colour pictures. These require for the development of a satisfactory studio technique an immense amount of further research. In the early days of the sound film, many thought that it would have a short life because the reproduction of both speech and music was so bad. Yet improvements have proceeded so rapidly that it is now so good that the demand for silent films has almost ceased. A similar series of events will probably take place in connexion with colour films. Most of the various attempts made to please the eye by two-colour processes have failed. It has taken years to put three-colour processes into practical form. But once the natural colour film has been seen by the public it seems that they will soon cease to think that it is a 'colour' picture and merely derive increased enjoyment from its naturalness. Similarly, the expert who is familiar with the latest developments of colour films feels when he looks at the ordinary film, notwithstanding the exquisite photography and the magnificent art which characterise modern productions, that a serious omission has been made.

The Past and the Future in Psychical Research

SIR OLIVER LODGE, in his presidential address to the Society for Psychical Research on the occasion of its jubilee in June, discussed the past and the future with special reference to the history of the Society. He recalled the events of the last fifty years and noted how the disapproval and hostility which was encountered in the early years of the Society's existence are gradually diminishing. The hostility, he maintained, was directed mainly by spiritualists, who disapproved of the cautious procedure of the Society's officers and of the criticism to which narratives were subjected before publication. Although this can scarcely be maintained at the present day, it is true that the founders of the Society, with the establishment of thought transference as their primary aim, were, in fact, endeavouring to apply the scientific method to their inquiries. In his insistence on this Sir Oliver is justified, in spite of such famous cases as that of Sir E. Hornby in 1884, where some attention to essential details would have absolved Mr. Frederic Myers and Mr. Edmund Gurney from charges of carelessness in the preparation of their data.

IN his further discussion of the past, Sir Oliver asked his audience to remember the pioneer work of Myers, who, although of literary and even perhaps mystical tendencies, nevertheless realised the importance of the scientific treatment of those problems which were his greatest interest. To convince the world of telepathy was the dominant note of the early years: to-day, Sir Oliver thinks, may be the time for the Society in its corporate capacity to declare its belief in the reality of the spiritual world and in its interaction with the physical one. It is on this note that the address ends, and it finally concludes by Sir Oliver again asserting his personal belief in the "cosmic and permanent" existence of the human spirit apart from the discarded material organism, with its memory, character and affections intact.

Deep Petroleum Wells

Mr. W. A. Sawdon contributes an interesting article to a recent issue of the *Oil Weekly* concerning the deepest oil wells yet drilled. The record which he gives proves conclusively the high state of efficiency to which petroleum engineering has attained in the last few years, and it would seem that, both from a technical and an economic point of view, the limit to the depth probed for oil has yet to be defined. The appearance of this article is timely owing to the fact that the deepest well drilled in the United States has just been completed in California, where a depth of 10,296 ft. has been reached. A feature of this well is that it was drilled with comparatively light equipment, contrary to the usual custom of involving extra heavy plant in order to achieve the great depths desired. This Californian well is not the deepest in the world, the record being held by a well drilled to 10,585 ft. in the State of Vera Cruz, Mexico. The first 10,000 ft. well to be drilled was, however, in California; this attained a depth of 10,054 ft. but, like the Mexican well, no production was obtained. Probably the greatest producing well is that which was completed in July last in California at a depth of 9,710 ft., from which an initial production of 5,050 barrels of oil a day, accompanied by 5,000,000 cub. ft. of gas, was obtained. All these wells were rotary drilled.

Two other interesting oil wells may be added to the list; one drilled by the percussion system (cable tool) in West Virginia to 9,104 ft., from which no production was obtained, the other, a Texas well, also drilled by the cable tool system to a depth of 8,900 ft. In the latter case a Diesel engine was employed as motive power instead of the more customary steam engine or electric motor as in the case of the other wells mentioned. Apart from technical development, in future the utility of the deep well will be governed entirely by economic circumstances, since any attempt to raise oil from a depth of two miles or more in the earth's crust must necessarily involve considerably greater expenditure in plant, equipment and running costs than has been the case in the past for shallower wells. There is little question that, assuming it is economically practicable, the petroleum engineering industry is capable of evolving both plant and operative system for attaining still greater depths, especially in cases where deeper-lying pay sands have to be tapped for the oil they contain. It is perhaps not difficult to visualise the day when over-production of oil will be a thing of the past and when reliance for the major part of the world's supply of crude petroleum will have to be placed on these very deep wells and on the revolutionised drilling technique which they imply.

Modern Methods in the Inland Telegraph Service

During the last two years, very rapid development has taken place in the inland telegraph service in Great Britain. Previously, a very exhaustive study had been made to find out the best methods of making the service more attractive to the public, more efficient as a means of communication, and less costly as regards the loss of State revenue. Instruments and machinery new to the service have been introduced. Teleprinters, typewriters, rectifiers, converters, thermionic valves and voice frequency signalling are the main features of the reorganised system. In a paper read to the Institution of Electrical Engineers on November 17, Mr. R. P. Smith described the new equipment in detail. A telegraph exchange service, 'the telex', has been made available to telephone subscribers, the necessary apparatus being installed on rental terms. The renters are able to receive and transmit printed communications in addition to the usual telephone facilities. They can also transmit messages to the Post Office, creating a new class of traffic designated 'Printergrams'—a word which we think not very happily chosen. We have now telegrams, phonograms and printergrams. At the present time, the supply of underground conductors is more than sufficient for the requirements of the public services. The vacant channels of communication are offered to the public, on rental terms, for the purpose of private wire circuits. The ascertained results of the reorganisation, which is still far from complete, show that the stability and accuracy of the service has been greatly increased. In addition, the latest figures show an improvement in the financial position. The changes also have increased the comfort and convenience of the army of workers who staff the telegraph instrument rooms.

Aerial Spotting of Fish Shoals

Since 1919, when the American Bureau of Fisheries first observed that fish shoals which could not be seen from the bridge of a ship were easily discernible from an aeroplane flying directly overhead, numerous attempts have been made to utilise aircraft for spotting shoals of fish. In Great Britain both the Ministry of Agriculture and Fisheries and the Scottish Fishery Board have made endeavours to locate herring shoals from the air but in both cases the experiments yielded no fruitful results. In the recently published report of the Danish Biological Station for 1932 interesting records of similar efforts to spot herring in Danish waters are given. Dr. H. Blegvad, director of the station, was in charge of the investigations and himself acted as observer. An important feature of the Danish experiments was that the Danish Broadcasting Corporation agreed to broadcast at once any information submitted to it from the exploring aeroplane. Unfortunately, only very few exceedingly small herring shoals were observed throughout the entire course of the investigations, which extended over forty flying hours. Their positions were immediately broadcast but the investigators were unable afterwards to obtain any information as to whether or not the broadcasts proved useful to the fishermen. Probably this entire lack of evidence is a very good indication of lack of positive results. The Danish investigators, therefore, like their British colleagues, have come to the

conclusion that, although in favourable conditions fish shoals in their waters may be spotted from the air, this method of locating fish is much too costly and uncertain to be of any practical value to the national fisheries.

The Future of Indian Agriculture

IN a survey and a forecast of the next twenty years in India (*Journal of the Royal Central Asian Society*, vol. 19, July 1932), Lieut.-Col. Sir Arnold Wilson makes a strong plea for the introduction of scientific method into public affairs. He predicts that in twenty years time the population of Asia will have increased by at least 20 per cent, and that in India alone the numbers may have grown to 427 millions. These figures mean that the great problem of the future will be that of food supply. Over the whole of Asia the predominant occupation is agriculture, while in India at least the cultivable area increases very slowly and seems to have reached the limit except for the redemption of barren areas by irrigation. Figures tend to show that in India the food yield has not kept pace with the growth of population, but that the gap has been partly filled by a decrease in the export of grain. Sir Arnold Wilson foresees the dwindling of this export trade and the growth of an import trade in wheat. To balance this, India will have to develop an export of other primary products, but the tendency will be to utilise these at home. An import of fertilisers will, however, be essential, for on the extended use of these in agriculture lies one of the few hopes for the avoidance of famine in the future and the maintenance of the present standard of living, low as it is.

Fenland Exploration in East Anglia

A COMMUNICATION from Mr. Miles C. Burkitt, which appears in *Man* for November, announces the inauguration of a committee for the exploration of the fens of East Anglia in connexion with the Cambridge Antiquarian Society and the Prehistoric Society of East Anglia. Recent archæological work in the area, notably a study of the prehistoric waterways by Major Fowler of Ely and of an early metal age site below peat by Mr. Grahame Clark, has served to demonstrate the importance of a region which can afford an unbroken sequence of deposits from quaternary to recent times. It is evident, however, that archæological investigation does not cover a sufficiently wide field for the complete study of the area, but needs supplementing by such studies, for example, as palæobotany and geology. It has, therefore, been decided, as already stated, to appoint a committee of experts to undertake systematic study in the various branches of scientific investigation between which co-operation is essential to a scheme of exploration. The Master of Downing, Prof. A. C. Seward, has consented to act as president and Major Fowler as vice-president of the Committee. Mr. Grahame Clark, Peterhouse, Cambridge, to whom communications relating to the work of the committee should be addressed, will act as secretary.

Rediscovery of an 'Extinct' Bird

RE-APPEARANCES of creatures regarded as extinct are occasionally reported but seldom proved. There can be no reasonable doubt, however, in the case of the black-capped petrel or 'diablotin' of Dominica, *Pterodroma hæsitata*. For many years this bird has been regarded as extinct, the last recorded capture having been made in 1871, but recently reports have become current that odd examples have been seen. The present position is summed up in a short article in the *Journal of the Society for the Preservation of the Fauna of the Empire* (Sept. 1932, p. 17). In 1900 Richmond stated that he had seen three, more have been observed in Haiti, and on May 2, 1932, Mary Rose (of Roseau, Dominica) invited a naturalist to examine a strange bird found lying helpless at her door after a stormy night. The naturalists who saw it (it died on May 26) agree that it was a 'diablotin'; and apparently the bird, although extremely rare, still breeds in the mountain fastnesses of Dominica. It is gratifying to find that steps were at once taken to ensure so far as possible the safety of the remnant, and on July 1 a special legislative order was issued granting the petrel full protection.

Magnetic Declination in the United States

THE U.S. Coast and Geodetic Survey makes magnetic observations at a set of repeat stations every five years, and publishes the results at similar intervals, in the form of tables of secular variation, and of charts showing the results of the original complete survey, made mainly between 1900 and 1910, brought up to date. A recent pamphlet by D. L. Hazard ("Magnetic Declination in the United States, 1930", U.S. Dept. of Commerce, Coast and Geodetic Survey, Washington; Serial 540, 1932; pp. 40, 10 cents) does this for the magnetic declination; the chart gives isogonic lines at 1° intervals, and lines of equal annual change at 1′ intervals. It contains much tabular matter and information of value to land surveyors, and is issued at a very low price.

Meldola Medal

THE Meldola medal (the gift of the Society of Maccabæans) is awarded annually to the chemist whose published chemical work shows the most promise and is brought to the notice of the administrators during the year ending December 31 prior to the award. The recipient must be a British subject not more than thirty years of age at the time of the completion of the work. The medal may not be awarded more than once to the same person. In awarding the medal for 1932, the adjudicators will, unless exceptional circumstances arise, give special consideration to work in physical or inorganic chemistry. The next award will be made in January 1933. The Council of the Institute of Chemistry would therefore be glad to have its attention directed, before December 31, to work of the character indicated. Communications should be addressed to the Registrar of the Institute, 30 Russell Square, London, W.C.1.

Announcements

THE Christmas Lectures at the Royal Institution are to be given by Prof. A. O. Rankine, professor of physics in the Imperial College of Science and Technology, on December 27, 29, 31, January 3, 5 and 7 at 3 o'clock. Prof. Rankine has chosen "The Round of the Waters" as the title of this, the "one hundred and seventh course of six lectures adapted to a juvenile auditory".

IT is announced by Science Service, Washington, D.C., that the John Fritz Gold Medal for 1932 of the American engineering institutions has been awarded to Daniel C. Jackling. Mr. Jackling, who has done much work in mining engineering and metallurgy, especially in the development of low-grade ores, was awarded the medal for "notable industrial achievement in initiating mass production of copper from low-grade ores, through application of engineering principles".

THE annual Congress of the Royal Institute of Public Health will be held at Eastbourne on May 30–June 4, under the presidency of the Right Hon. Viscount Leverhulme. The Congress will be divided into five sections: State medicine and industrial hygiene; women and children and the public health; tuberculosis; pathology, bacteriology, biochemistry and veterinary medicine; climatology and hydrology. Further information can be obtained from the Secretary, 23 Queen Square, London, W.C.1.

THE trustees of the Rockefeller Foundation have made a further grant of £5,000 towards the research funds of the National Institute of Industrial Psychology to be expended in the years 1933–1936. This is the fourth grant made by these trustees to the Institute. These gifts have enabled the Institute, under the personal direction of Dr. C. S. Myers, its principal, to conduct an extensive series of researches upon subjects having a direct bearing on industrial and occupational life.

AT the annual general meeting of the Philosophical Society of the University of Durham the following officers were elected for the session 1932–33: *President:* Prof. R. A. Sampson; *Vice-Presidents:* Profs. J. W. H. Harrison, P. J. Heawood, G. R. Goldsbrough, G. R. Clemo, G. H. Hickling, and J. Irvine Masson; *Hon. General Secretary:* Mr. W. M. Madgin; *Hon. Treasurer:* Mr. J. W. Bullerwell; *Editor:* Prof. G. W. Todd; and *Hon. Librarian:* Dr. F. Bradshaw.

DR. J. Florian, Brno, Czechoslovakia, writes to point out that in his article on "The Early History of the Cell Theory" in NATURE of October 22 the first sentence of the second paragraph should read:—"Studnička came to the conclusion that the small granules ('globules') of 1/300 mm. in diameter, which H. Milne Edwards (1823) found in all the tissues he examined, are of varied origin and in great part mere artefacts." By a misunderstanding, for which the correspondent who sent us the article is responsible, the sentence read: "In 1823 H. Milne Edwards came to the conclusion that the small granules ('globules') of 1/300 mm. in diameter," etc. Dr. Florian saw a proof but unfortunately overlooked the alteration which had been made in the sentence.

IT is announced in *Science* of October 28, that the ninety-first meeting of the American Association for the Advancement of Science will be held at Atlantic City on December 27–31, under the presidency of Dr. John J. Abel. The opening general address will be delivered by the retiring president, Dr. Franz Boas. The first Maiben lecture, a new lecture established in memory of H. Maiben, will be given by Dr. H. N. Russell on "The Constitution of the Stars". The general headquarters of the Association will be Chalfonte-Haddon Hall, which will also house the members representing general science. On the other hand, members of the various sections of the Association will stay in definite hotels allocated to each section. So far as is possible, each section will hold its meetings at the hotel thus assigned to it.

ARRANGEMENTS have been made for Dr. Davidson Black of the Peiping Union Medical College, China, who will arrive in England early in December, to give a course of lectures in advanced anatomy in the University of London. The course, consisting of two lectures on *Sinanthropus*, will be given at University College, Gower Street, London, W.C.1. The first lecture will be delivered on Friday, December 9, at 5.30 P.M., and the second on Monday, December 12, at the same time. In addition to an account of the morphological characters of *Sinanthropus*, the lectures will include a historical statement and a description of the environment, physical and biotic, and the cultural horizon. Admission to all the lectures will be free and without ticket.

IN a review in NATURE of November 5, p. 682, reference is made to the transparent cellulose film "Cellophane". We have been asked to point out that this name is the registered trade mark used by The Cellophane Co., Ltd., and its associated companies to designate their product.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in chemistry (subsidiary botany) at the Woolwich Polytechnic, Woolwich, S.E.18—The Secretary (Nov. 29). A county librarian for the Buckinghamshire County Education Committee—The Secretary for Education, County Offices, Aylesbury (Nov. 29). A temporary junior chemist at an Admiralty inspection establishment—The Secretary of the Admiralty (C.E. Branch), London, S.W.1 (Dec. 10). An assistant librarian at the University of Glasgow—The Librarian (Dec. 15). A field geologist for economic investigation (not oil) in Iraq—The Crown Agents for the Colonies, 4, Millbank, Westminster, S.W.1 (Dec. 17).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Quantitative Estimates of Sensory Events

DR. ALLAN FERGUSON's article on Weber's law in NATURE of September 3 (p. 334) is to be welcomed as an eminently sane statement on a subject about which much nonsense has been talked. Fechner's work has been too much attacked by verbal discussion on the nature of measurement which Dr. Ferguson rightly criticises.

This speculative discussion has directed the attention of Fechner's critics from a serious mathematical blunder. Fechner integrated for the whole value of R values from zero upwards (assuming, therefore, that Weber's law held over this whole range), but after integration, he made a substitution which assumes the existence of an absolute threshold of stimulus below which there is no sensation (which is plainly inconsistent with the truth of Weber's law at low R values). This leads to the absurdity of negative sensation values when the stimulus is below threshold value, and the crowning absurdity of an infinite negative sensation for zero stimulus. This defect, however, is not fatal to Fechner's work and may be avoided by the method adopted by Dr. Ferguson of integrating only over the range of R values in which Weber's law, in fact, holds.

A further difficulty, however, arises from the fact that it is not certain that there is any range of stimulus intensities over which Weber's law is valid. The method of experimenting which has commonly been used on the authority of Fechner (that is, asking the subject for a judgment as to which of two stimuli is greater) does not give very self-consistent results, so no very close approximation to any law can be expected. Using Weber's original kind of stimulus—pressure—and a simpler experimental method giving greater self-consistency, I have found no indication of a tendency for $\Delta R/R$ to be constant. Any relationship is complicated by the fact that different kinds of sense organs are stimulated at different intensities of pressure, but an overlapping system of curves approximating to Houstoun's law seems a more probable explanation of the results obtained. This does not seem to be a mere result of a change in experimental method, since the old results given in the textbooks seem, on critical examination, to give no real support to Weber's law. Results commonly stated to be 'near enough to Weber's law' (such as Max Wien's on sound intensities), when reduced to a graph, are not very much like a straight line parallel to the base. Many such 'confirmations' of Weber's law prove on examination to be, in Mark Twain's words, a little straighter than a corkscrew but not so straight as a rainbow.

Dr. Ferguson is undoubtedly right in suggesting that the real problem of Fechner's work is unaffected by whether we start from Weber's law or some more complex relationship between R and S. The assumption in the passage from a law connecting differential thresholds with absolute values of the stimulus to a formula of the general form $S = f(R)$ or $S_1 - S_2 = f(R_1, R_2)$, (Fechner's implied assumption that just perceptible increments of sensation are equal sensation increments) may be regarded as a convention of measurement comparable with Fahrenheit's convention that he would take as equal temperature steps those that made equal volume increases in his mercury. If this convention gives us a system of numerical coefficients consistent with the experimental facts of judgments of relative supraliminal sensation differences (as apparently it does), it matters little whether or not we are to be allowed to call this process 'measurement' or by some other name.

It must be agreed that the conception of the sense interval is a mere evasion of the difficulties of the sensation. Several years ago, I described experiments at a British Association meeting which showed that the absolute sense interval involves precisely the same difficulties as the absolute sensation magnitude.

The greatest harm to the development of experimental psychology has come from Weber's law and not from Fechner's work. Fechner has contributed to this harm by focusing attention on Weber's law. The harm has been two-fold. First, experimenters have for half a century been occupied with trying to confirm or refute Weber's law, instead of with the real problem of trying to establish the more complex relationship which really holds between sensation and stimulus intensity. Much worse is the fact that they have been almost entirely occupied with those conditions of simplified perception in which alone sensation intensity is simply a function of stimulus intensity, and have neglected the much more important and interesting problems of perception which arise under less artificial conditions in which the perceptual experience is a function of the total experimental setting.

ROBERT H. THOULESS.

Dept. of Psychology,
University, Glasgow.
Sept. 7.

DR. FERGUSON's discussion in NATURE of September 3 (p. 334) would have been briefer and possibly clearer if he had based it upon the general principles of measurement. These have been recently formulated by several independent writers; it is true they are not generally known, but they never will be if everyone refuses to refer to them. The chief of them may be stated briefly thus:—There are two distinct processes of measurement; one of these ('fundamental') is based on the recognition of a relation of equality and a process of addition, obeying certain laws; the other ('derived') consists in the assignment of a numeral representing the constant of a numerical law. Let us apply these to sensations.

In so far as the law

$$\delta R = kR$$

is valid, k is a true *derived* magnitude, exactly co-ordinate with density or viscosity. But that does not afford the smallest presumption that there is a *fundamental* magnitude S, between values of which the k's are differences; it is that presumption that has misled the followers of Fechner. It is certainly improbable that a quantitative science of sensation can be established unless a *fundamental* magnitude characteristic of it can be found; but the way to find such a magnitude is to seek for a process of addition, not to juggle mathematically with numerical laws.

The success of the search depends largely on what is meant by a sensation. Some psychologists hold that two sensations of the same kind cannot be experienced simultaneously. If they are right (and the question is not entirely one of words), sensations cannot possibly be measurable fundamentally; for it is quite certain that there is no process of addition whereby two non-simultaneous sensations can be combined so as to be equivalent to a single instantaneous sensation. If, on the other hand, we experience two simultaneous sensations when exposed to two stimuli, sensations can be combined and it is a question of experimental fact whether such combination satisfies the laws of addition. The most likely of these to fail is the associative law that, if a is equivalent to a' and b to b', then a combined with b is equivalent to a' combined with b'. For the sensation of brightness, this law (and certain others) are true within limits; that is why heterochromatic photometry is possible. Those who dismiss it as irrelevant on the ground that it measures stimuli and not sensations often fail to observe that heterochromatic brightness differs from homochromatic brightness and other typically physical magnitudes, because it cannot be measured by 'physical' methods, independent of any *specified* form of sensation; its measurement is inseparable from a sensation of a particular kind.

The law need not, however, be true for sensations of other kinds. It is almost certainly untrue for painfulness; and I doubt whether it is generally true for loudness. The loudness of added sounds is probably affected by their concordance or dissonance. But the experiments that might decide the matter definitely do not seem to have been made; until they are made, it is waste of time to discuss whether sensations are measurable.

Some people seem to believe that, though sensations are not measurable by either of the two physical processes, they may be measurable by some third process inapplicable to the magnitudes of physics. They should remember that physicists will not accept any process as measurement, unless it is based upon laws the validity of which is appreciable equally by all observers who are not so abnormal as to fail to appreciate their meaning.

NORMAN R. CAMPBELL.

THE two letters printed above emphasise the necessity for further discussion of the problem—a discussion which may very well be applied both to the vast mass of existing experimental data, and to the conditions under which fresh data may be sought.

The reason for the line of development adopted in my article will be apparent to anyone acquainted with the literature of the subject; and, as was pointed out clearly enough in the text, one of the primary matters to be considered in a future discussion is that of the application to the problem of the fundamental principles of measurement, the importance of which Dr. Campbell so rightly stresses. Anything that Dr. Campbell has to say on such a subject will be heard with respect; nonetheless, readers of his incisive letter should remember that a vigorous statement is not necessarily a final statement of the truth.

ALLAN FERGUSON.

70 Hadham Road,
Bishop's Stortford,
Herts.

Lubricating Oils and Cancer

THE letter from J. B. Speakman and N. H. Chamberlain,[1] suggesting that "the incidence of dermatitis and tumours may be caused by the difficulty of removing mineral oil from the skin", is supported by the fact that unsaturated mineral oils on exposure to light and air form compounds which are not emulsified by soaps, and which form coatings on wool fibres that are only removed with difficulty by solvents, and not at all by soaps. This insoluble layer is a possible source of irritation. Crude shale oils give a considerable amount of such insoluble compounds.[2]

Also, in the course of research work by the second of the undersigned, on emulsification problems in scouring of wool and wool fabrics, it has been noted that the ionisation process developed by E. V. Hayes-Gratze in co-operation with the Wool Industries Research Association, applied to a variety of oils, especially vegetable oils, gives striking results.

It gives products of greatly lowered surface tension, and highly water-emulsifiable nature, providing a means of wool oiling whereby not only are "oxidised oil" defects, to which commercial lanoline is subject, eliminated, but subsequent scouring is accomplished with the greatest ease.

In addition, hospital tests have shown that ionised oils possess remarkable curative properties in treatment of obstinate cases of dermatitis and ringworm, so that it may be inferred that their presence would tend to prevent skin infection, apart from facilitating removal of oil contamination.

H. R. HIRST.
A. T. KING.

Wool Industries Research Association,
Headingley, Leeds.
Nov. 7.

[1] NATURE, 130, 578, Oct. 15, 1932.
[2] Hirst, *J. Soc. Dyers and Col.*, Dec. 1931.

A Continuous Spectrum of Pure Argon

IN the course of investigations that have been made at the Electrical Laboratory, Oxford, of the electrical properties of argon, it was found that when the gas is obtained in a high degree of purity several phenomena occur, in the appearance of the discharge and in the spectrum of the light emitted, which do not appear to have been noticed before. The argon was carefully purified by a method which will be described in another paper. It was examined spectroscopically at pressures from 1 millimetre to 150 millimetres and no lines due to impurities were detected in the range of wave-lengths from λ 2000 A. to λ 7000 A.

It was found that when an electrodeless discharge was excited in argon by continuous oscillations of about 100 metres wave-length in a tube 1·7 cm. in diameter, the discharge assumes two forms which depend upon the pressure of the gas and the intensity of the current. When the current in the tube is large, the discharge is a striated column, the striations consisting of globules (the size of which decreases as the pressure is increased) which lie along the axis of the tube between the electrodes; a form of the discharge which has already been described in a previous paper.[1] A recent photograph of this type of discharge in pure argon at about 40 mm. pressure is shown in Fig. 1. When the current in the tube is decreased, the striations disappear and the distribution of light in the tube takes the form shown in Fig. 2. In the striated column the colour

is purple and in the uniform column the colour is white. In a tube of 1·7 cm. diameter, at pressures less than 8 mm., it was not found possible to obtain the uniform column, and the discharge was striated for the smallest currents which could be maintained

FIG. 1.

in the tube. Similar results were obtained in wider tubes, both of pyrex and of quartz.

The spectra emitted by the luminous column in the two types of discharge exhibit interesting variations as the pressure is increased. When the pressure is less than about 6 mm., only the line spectrum

FIG. 2.

of argon is excited. As the pressure is increased, a continuous background appears which increases in intensity with the pressure, while the line spectrum becomes less intense. At the highest pressures (80–150 mm.) the line spectrum is completely absent from the uniform column with the exception of the

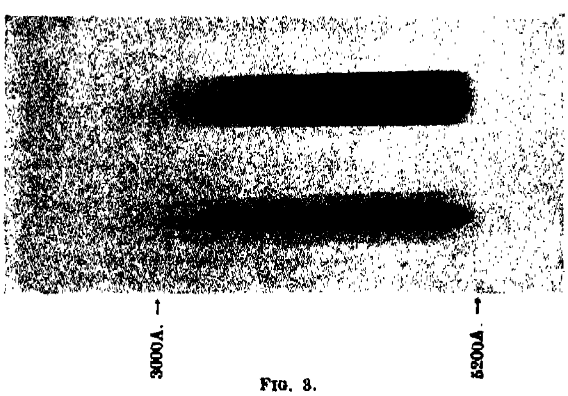

FIG. 3.

argon red line at λ 6965 A. The spectrum appears quite continuous from 6000 A. to about 2250 A., which is as far as can be measured with the spectrograph used. At the highest pressures in the striated column the continuous background appears as strongly as in the uniform column, but in addition the stronger lines of the argon red spectrum are visible above the continuous background.

Photographs of the spectrum of the striated and continuous discharges obtained in pyrex tubes containing argon at a pressure of 150 mm. are shown in Fig. 3. These were taken on Ilford Zenith 650 plates. Photographs will be published later of the spectra obtained with quartz tubes and panchromatic plates. These plates show the continuous spectrum sharply cut off at about λ 6000 A. and extending as far into the ultra-violet as can be measured with a quartz spectrograph in air, while the red line at λ 6965 A. appears prominently.

A very interesting feature of these investigations is that they show that it is possible to obtain a continuous spectrum in a gas discharge, over a wide range of wave-lengths, where the characteristic lines of the gas are absent.

S. P. McCALLUM.
L. KLATZOW.
J. E. KEYSTON.

Electrical Laboratory,
Oxford.
Oct. 30.

[1] S. P. McCallum and W. T. Perry, NATURE, 124, 984, Dec. 28, 1929.

Continuous Spectrum of Sodium

I HAVE investigated the intensity distribution of the continuous spectrum of sodium, which is generally considered to be the halo of the D lines, and also of the relative intensity to the systems of discrete bands, under various conditions of excitation, and the main results obtained are here described.

The continuous spectrum begins to enhance when the pressure is increased to 1–2 mm., and as the pressure of vapour is increased more and more, without altering the temperature, the intensity of the discrete bands as well as that of the continuous spectrum are both increased considerably, the increasing rate of the former being greater than that of the latter.

Where the temperature of the vapour varies under a constant pressure, it is known that the more intensely the discrete bands are emitted, compared with the continuous spectrum, the lower the temperature of the vapour, but as the temperature of the vapour becomes higher, the case is reversed.

The intensity distribution of the continuous spectrum is nearly symmetrical on both sides of the wave-lengths and is at a remarkable maximum at the D lines, and the rise of temperature, without altering the pressure, or increase of pressure, the temperature being kept constant, causes the relative or absolute enhancement and, therefore, the (apparent) broadening of the spectrum. In the region of the shorter wave-lengths, its intensity decreases moderately at about 5600 A. and fades abruptly with a comparatively sharp edge at about 5500 A., and as we proceed farther towards the side of the shorter wave-lengths, the intensity of the weak continuous spectrum gradually decreases and terminates more or less abruptly at about 4550 A., while, on the side of the longer wave-lengths, its intensity is gradually and uniformly decreased.

The rotation structure is always sharply defined without showing any appreciable broadening of the band-lines as the result of the increase of pressure, and also of the rise of the temperature, until the condition (very high temperature) is arrived at where the discrete bands, and therefore each separate band-

line, ultimately disappear. It is proved that there is no direct connexion between the structure of the discrete bands and the continuous spectrum.

The continuous spectrum mentioned above may certainly be explained by the emission of the excited ^3P atoms during their collisions with other normal atoms (quasi-molecules). It seems that the emission of the main part of the strong continuous spectrum in the back-ground of the red band system is closely connected with the transitions $^1\Sigma_u^+ \to {}^1\Sigma_g^+$ of the quasi-molecules. Similarly, the continuous spectrum

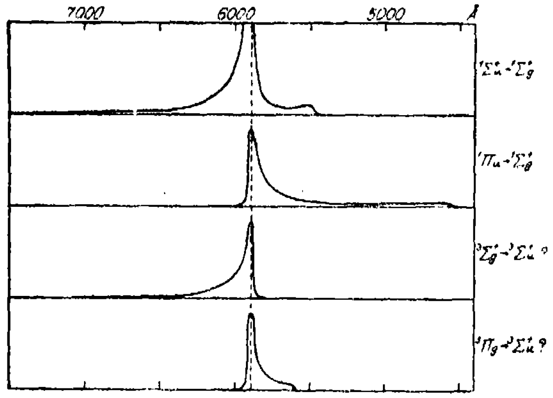

FIG. 1.

in the back-ground of the green band system seems to have an intimate connexion with the latter band system ($^1\pi_u \to {}^1\Sigma_g^+$). Besides, there is also possible the emission of a continuous spectrum due to the transitions $^3\Sigma_g^+ \to {}^3\Sigma_u^+$ and $^3\pi_g \to {}^3\Sigma_u^+$ of the quasi-molecules on the side of the longer wave-lengths of the D lines, or in the vicinity of them (Fig. 1).

The main part of the continuous spectrum emitted from the sodium arc, or from the sodium flame, when the density of sodium vapour is fairly high, has the same distribution of intensity as that obtained in this experiment.

Similar results are obtained in the case of potassium.

H. HAMADA.

Physical Institute,
Sendai, Japan.
Sept. 24.

Discontinuous Distribution in Plants

IN NATURE of July 9, p. 58, I gave an account of a genus of bees (*Hesperapis*) which was found to exist in dry regions of the south-west United States, and again in the dry parts of South Africa. I have just received from the Missouri Botanical Garden a very thorough revision of the genus *Menodora*, by Julian A. Steyermark. This is a genus of oleaceous plants, found in dry or semi-desert regions, in south-west North America, a large area in Central and southern South America, and a few forms in the Transvaal and adjacent parts of South Africa. Thus except for the South American area, the distribution nearly corresponds with that of *Hesperapis*.

One of the South African forms, certainly native and frequently collected in the Transvaal, has been supposed to be identical with *Menodora heterophylla*, which is abundant in Texas, and occurs in the Mexican States of Tamaulipas and Nuevo Leon. Mr. Steyermark points out that in spite of the great resemblance, the South African plant differs in a number of respects, so that he calls it variety *australis*. Evidently it should rank as a separate species, *Menodora australis*, as it cannot be supposed to have any direct genetic connexion with the North American plant. Mr. Steyermark himself calls it "a very striking instance, seemingly, of parallel development". On p. 109, however, he writes: "*M. heterophylla*, occurs with its variety in two widely separated continents, namely, North America and Africa. Since this distribution may be explained by the supposition of the existence of a land-bridge forming a ready means of dispersal for species between the continents, it may be supposed that *M. heterophylla* extended from North America to South Africa over the postulated lost continent, Gondwana, before the end of the Cretaceous."

This seems to me to be wholly fanciful, and had there been any such connexion, is it likely that this species of plants has remained unchanged since the Cretaceous, or that a few forms crossed over, leaving the mass of the fauna and flora behind? There is no reason to doubt that the genera *Menodora* and *Hesperapis* are of great antiquity, and presumably spread to their now remote outposts by way of Asia, but very similar species have evolved independently under similar conditions. Unfortunately xerophytic conditions are not favourable for the preservation of fossil plants and insects, so that we get very little evidence from the rocks concerning the past plant or invertebrate life of dry regions. We do, however, find in the Miocene deposit at Florissant, Colorado, fossil Proteaceæ, a family of plants now especially characteristic of South Africa and Australia, and a species of Nemopteridæ, curious insects with long slender hind wings, known from southern South America and dry regions of the Old World, but to-day wholly lacking in North America.

The distribution and origin of desert life may well attract all students interested in the wider aspects of biology. After visiting desert and semi-desert regions in many parts of the world, one is struck by the extraordinary character of the responses to the environment, producing similar and highly characteristic organisms, often of quite different origin. Judging by the completeness of the adaptations, and the great number of peculiar types, it seems that the South African desert area has some claim to be considered the oldest of them all.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado.
Oct. 7.

Protective Properties of Colloids and their Behaviour in the Electrolytic Deposition of Metals

PREVIOUS observations made by me[1] on the mechanical stress in cathode plates during electrolysis of copper sulphate, showed that the effect of gelatin in the solutions is marked at very low concentrations (0·5–1 mgm. per litre). The state of the solution is also of great importance, the stress varying considerably with the age of the solution. This makes it possible to follow the evolution of a solution as a function of time by the electrochemical method.

I have continued my experiments with other colloids: serum albumin, gum arabic, gum tragacanth, and dextrin, in concentrations varying from 1 to 500 mgm. per litre. The results show a very

pronounced parallelism between the protective action as measured by the gold number of the colloid substance and its action on the electrolytic deposit. Highly protective substances (gelatin and serum albumin) modify considerably the stress in the copper, whereas the less protective (gum arabic and gum tragacanth) have a much smaller effect. The dextrin with its very high gold number has no effect in the limits of the concentrations examined.

These results show that the effect produced by the colloids on the electrolytic copper deposit must be attributed mainly to phenomena similar to those manifested in protective actions, that is, they have to be brought back finally to adsorption.

P. A. JACQUET.

Laboratoire d'Electrochimie,
Ecole Pratique des Hautes Etudes,
Paris (V°)

[1] C. R. Acad. Sci., Paris, **194**, 456, 870; 1932.

Application of the Gold-Beater's Skin Test to Some Synthetic Tannins

IN several communications[1] we have shown that the generally accepted reactions for the tannins are quite unreliable, with the result that the abovenamed test was evolved.[2] The gold-beater's skin test demonstrates the *tanning* properties of a substance, and is given *only* by true tannins. Its application to the following synthetic tannins, prepared according to Emil Fischer,[3] digalloylglycol, trigalloyl-glycerin, tetragalloyl-erythrol and hexagalloyl-mannitol, shows them to possess no tanning properties whatever. These observations thus extend my objections,[4] since further emphasised by Tschitschibabin,[5] to Fischer's galloyl-glucose formula of gallotannin.

M. NIERENSTEIN.

The University,
Bristol.

[1] Jones, *Analyst*, **52**, 275; 1927; **53**, 429; 1928. Fear, *ibid.*, **54**, 227, 316; 1929.
[2] Atkinson and Hazleton, *Biochem. J.*, **16**, 516; 1922. Price, *Analyst*, **49**, 25, 336; 1924.
[3] Fischer and Bergmann, *Berichte*, **52**, 829; 1919.
[4] Nierenstein, Spiers and Geake, *J. Chem. Soc.*, **119**, 275; 1921. Nierenstein, Spiers and Hadley, *J. Amer. Chem. Soc.*, **47**, 1726; 1925.
[5] Tschitschibabin, Kirsanow and Korolew, *Annalen*, **469**, 93; 1929.

Inheritance of Acquired Characters

THE response evoked by my letter in NATURE of October 1 calls for a reply. Dr. R. A. Fisher, in his interesting communication,[1] points out that before my conclusion is accepted there are one or two preliminary points to be considered. His suggestion that the somewhat retarded ages of fatherhood of the upper and middle classes would alone explain the greater age of paternity cannot, I think, be accepted: the frequency curve would surely be displaced so as to be substantially parallel to the normal curve, but this is not the observed fact. Again, Dr. Fisher states that the comparison would be more valid if based upon birth order: I venture to suggest that this is quite a different proposition, although ability is undoubtedly correlated with birth order. The suggestion that the differences may be due to environmental modifications is a more plausible one but it cannot, I think, be sustained: a father seventy years of age is not likely either to survive to influence his child during the critical years of adolescence or to provide a substantially better environment than a father fifty years of age.

If my thesis is true it is important eugenically, since there emerges the possibility of materially improving a stock in one generation. In this connexion the tradition that Isaac was born when Abraham was an hundred years old and Sarah ninety is interesting, seeing that from him sprang the whole Jewish race. The story in *Genesis* is very circumstantial and emphasises that both parents were old and well stricken in age. It is commonly held, I believe, that such progeny is necessarily degenerate.

A. F. DUFTON.

Greenbank, Garston,
Hertfordshire.
Oct. 22.

[1] NATURE, **130**, 579, Oct. 15, 1932.

Ecology of Man's Ancestors

IN his recent book "The Causes of Evolution" (p. 10) Prof. J. B. S. Haldane makes the following incidental remark: "Thus that common enemy of man, the bed-bug belongs to a family whose members are mostly parasitic on bats. Dr. Buxton has, I think, suggested that it is a relic of the association of our palæolithic ancestors with bats in caves." It is, indeed, interesting to note that a number of other animals associated with man and his immediate environment belong to the ecological group of rock and cave communities. The members of the family Cimicidæ to which the bed-bug belongs are predaceous (not parasitic in the strict sense of the word) not only on man and bats, but also on pigeons and house-martins, and the original habitat of these birds, as well as of swallows, is amongst cliffs and in caves. The predaceous bug *Reduvius personatus*, often preying on the bed-bug, is found only in houses and sheds, but other species of the genus occur amongst stones, in rock crevices, etc., in the Mediterranean region. The same largely applies to the house-cricket and to the myriapod, *Scutigera*. The typical cave bugs belonging to the subfamily *Emesinæ* are represented in the animal community grouped around man by several species of the genus *Ploiaria* (for example, *P. domestica*). The geckos are typical rock animals but they are just as commonly found on the walls of houses.

All these facts lend strong support to the hypothesis that man originally belonged to the community of cave-inhabiting animals rather than of forest-dwellers such as the anthropoid apes. It would be of great interest to make a thorough analysis of the animals commensal with man in various countries with regard to their systematic, zoogeographical and ecological relations, since this may throw some light on the early history of mankind. So far as we know, this much discussed problem has not yet been attacked from the ecological point of view.

W. E. CHINA.
B. P. UVAROV.

British Museum (Natural History),
London, S.W.7,
Nov. 1.

Implements from the Raised Beach at Slindon Park, Sussex

WITH the help of a grant from the Percy Sladen Memorial Fund, I have recently examined the raised beach at Slindon Park, situated between Arundel and Chichester.

The section shows some 8 ft. of raised beach, consisting mainly of flint cobbles. Its surface lies

at about 135 ft. above O.D., and is covered by a deposit of Coombe Rock, varying from 6 in. to 9 ft. deep. Three main facts result from my investigation:

(1) The raised beach contains Chellean hand-axes and large thick flakes, both much rolled.
(2) At the top of the beach occur Acheulean ovates.
(3) Next comes a flake industry, which preceded the deposition of the Coombe Rock.

(1) The large flakes from the beach closely resemble in form and colour those found in the Cannon shot gravels of Norfolk. There are traces of striation. Some are reminiscent of Clacton types.

(2) From the top of the beach come several Acheulean ovates. Some are moderately rolled and battered; others are unabraded. We are probably dealing with a storm beach, which was occasionally subjected to the action of the sea. The subsidence involved is about 120-125 ft.

(3) The lowest part of the Coombe Rock contains a floor yielding remains of a flake industry. There are Levallois flakes with facetted platforms, and flakes struck from unprepared cores. The industry includes rough hand-axes, both ovate in shape, and with squared corners, also choppers and large points, 'Abri Audi' in form.

From the 80-90 ft. raised beach south-west of Slindon Park, I have obtained several rolled flakes of Cannon shot gravel type.

I suggest that much of the beach belongs to the same interglacial period as the Cannon shot gravels. Its latest phase may be contemporary with (a) gravel deposits at Corfe Mullen near Wimborne in the Hampshire basin, where the surface of the gravel is about 135 ft. above the river; (b) the Dartford Heath gravel in the lower Thames valley, where the top of the gravel reaches 137 ft. above O.D. Both these sites contain late Acheulean ovates.

The Coombe Rock at Slindon readily falls into line with a similar deposit which buried the early Mousterian workshop at Northfleet, and with the Upper Chalky Boulder Clay of East Anglia which succeeded early Mousterian cultures at Hoxne and Foxhall Road, Ipswich.

Mr. J. Reid Moir has kindly examined my material, and is in agreement with my general conclusions. A full report will be published in due course.

J. BERNARD CALKIN.

Wychwood School,
Bournemouth.
Nov. 2.

Angle of Elevation of Short Wave Rays

AN important problem in short wave propagation from both the purely scientific and the commercial aspect concerns the angle of elevation of the path of the ray both at the transmitting and receiving end.

During the past year the Radio Section of the Post Office Engineering Department has been investigating this problem. At Rugby Radio Station, energised aerials consisting of one or more tiers of horizontal radiators have been raised in stages from the ground and the resulting field has been measured near New York by the staff of the American Telephone and Telegraph Co., and the Bell Telephone Laboratories, who have closely collaborated in the tests. By plotting a series of curves giving the relative field strength of the rays projected at various angles of elevation as the aerials were raised and comparing with the received fields, it has been possible to ascertain the direction taken by the ray at the transmitting end. The details of the tests will be published later. In the meantime it is relevant to record that the usually accepted theory that for long distance transmission almost grazing angle to the earth gives the best distant field is inaccurate in the case of the Rugby-New York circuit. The investigation shows that during the past year the best angle of projection of waves traversing an all light path has varied only $\pm 2°$ or $3°$ from $10°$ to the horizontal.

Aerials giving rise to beams of varying concentration having their maximum radiation at angles of elevation changing from 5° to 10° have shown in all cases that the average field as measured at the receiving end has corresponded approximately to that portion of the energy radiated along a direction having an angle of elevation of 10°. Field-strength measurements made in Berlin and Teneriffe by the courtesy of Herr Baumler of the Reichspostzentralamt, and Mr. W. H. Warren of the Compania Telefonica National des Espana, confirm that there is a definite angle of projection of energy along which attenuation is a minimum.

This angle is not necessarily the lowest to give a minimum number of reflections from the F layer associated with the name of Prof. E. V. Appleton.

T. WALMSLEY.

General Post Office (Radio Section),
86 Wood Street, London, E.C.2,
Oct. 31.

Dr. William Garnett

THE obituary notice of Dr. Garnett in NATURE of November 12 omits to mention his long connexion with the Royal Commission for the Exhibition of 1851; and as Dr. Garnett was justly proud of his membership of this body, perhaps a supplementary note may be of interest. The facts are these: Dr. Garnett was an original member of Lord Playfair's committee which devised and introduced the Commissioners' scheme of research scholarships, a scheme which has done so much for the improvement of scientific education both at home and overseas, and has also contributed in no small measure to the advancement of science. From 1890 until a few months ago, Dr. Garnett served without intermission as a member of the Science Scholarships Committee of the Royal Commission, and his recent resignation from that body, prompted by increasing deafness which latterly prevented him from following discussions at meetings, deprived the Committee of its senior member and its oldest friend; and now his death removes the last link with that eminent body of men of science to whose wisdom and foresight higher education in Great Britain owes so much. I am privileged to know that, on his relinquishing his active participation in the affairs of the Royal Commission, Dr. Garnett received from H.M. the King a most gracious message of appreciation of the valuable services which he had rendered to the Commission for more than forty years. I believe that readers of NATURE will be glad to have their attention directed to this further aspect of his long and useful life.

EVELYN SHAW.

1 Lowther Gardens,
Exhibition Road, S.W.7.
Nov. 14.

Research Items

Peking Man.—The skeletal remains other than the skull parts of Peking man, of which the announcement of the discovery was purposely delayed, have now been described by Dr. Davidson Black (*Bull. Geol. Soc. China*, 11, No. 4) The greater part of a left semi-lunar bone (os lunatum) was found by Dr. Bohler in material from Locus *B* of the Choukoutien cave. It is undoubtedly to be referred to the genus *Sinanthropus*. It differs in no important respect from that of modern man and confirms the inference from the stone implements, crude though they are, that the hands of Peking man were essentially like our own. In a culture stratum yielding quartz implements, from which came two adult jaw fragments and a parietal fragment of *Sinanthropus*, was also found a fragment of clavicle. It is the greater part of the shaft of a well-formed left clavicle lacking the sternal epiphyseal articular portion and the acromial fourth of the bone. It is moderately mineralised and a dark reddish-brown. The individual from whom it was derived was probably adult. The probable length, 15 cm., is about the average length of an adult modern North China male clavicle. A number of anomalous terminal phalanges have also been recovered, which could not well have belonged to any animal other than a hominid form. Expert opinion confirms this. In the first specimen recovered, the roughened area of the tuberositas unguicularis encroaches on the dorsal surface of the bone more widely, while ventrally it is much less developed, than in any known hominid. If it is the terminal phalanx of the hallux of *Sinanthropus*, it would seem probable that the morphology of the feet of this form and that of modern man differed much more widely from one another than that of their hands.

Pueblos on Zuñi Reservation.—The excavation of an ancient Pueblo site on the Zuñi Reservation, New Mexico, is described by Mr. F. H. H. Roberts, jr., in Bull. 111, of the Bureau of American Ethnology. When the site was excavated in 1930 it was found that the settlement consisted of three communal dwellings and two great kivas or ceremonial chambers. On account of the latter feature the site is to be known as the "Village of the Great Kivas". Two dwellings and one kiva were completely excavated. The larger dwelling consisted of three small ceremonial chambers, a great kiva and sixty-four rooms, of which four had constituted a second story. In addition there were four detached subterranean ceremonial chambers in front of the east end. The building had not been erected as one unit, but there had been several periods of constructive activity. The original structure was a rectangular block of thirteen rooms and two small ceremonial chambers. Up to the close of at least the first two of the periods of activity, the house type was predominantly that of the Chaco canyon, that is, of the northern Pueblo type. The character and size of later additions suggest an infiltration of other peoples, probably from the south. The kivas associated with the house are of two types. The smaller house contained twenty rooms. Originally a fairly small dwelling, it had been enlarged at various times. The material was more carefully worked than in house A. It had no kiva, another indication of its probably southern origin. Sixty burials were uncovered; but the remains were in poor condition. The skulls showed pronounced occipital flattening and a large proportion of decayed teeth, the latter feature probably being due to a deficiency in diet. The village seems to have had a population of about 100. It belongs to Pueblo III and dates from about A.D. 1000–1030, the period of Pueblo expansion.

Tuberculosis in Children.—Our knowledge of the pathology and bacteriology of tuberculosis in children has been extended by the work of Dr. J. W. S. Blacklock, detailed in a report issued by the Medical Research Council (Special Report Series, No. 172. London: H.M. Stationery Office. 3*s*. net). It supplies additional evidence of the paths by which infection comes, based upon a study of the primary sites in which the disease developed in 283 children found at autopsy to be tuberculous. The ages of the subjects were from a few hours up to thirteen years. Of these 283 children with tuberculous damage, more than 90 per cent died as the result of the infection; the site of the primary damage was most frequently in the chest (173 cases, or 61 per cent). Evidence was sought of the pathway of infection to the lung and lymphatic glands. For this purpose, a characteristic lung lesion described by Parrot half a century ago and recognised as marking the primary site of infection was sought for; this was found in 148 of the 173 cases, and the tubercle bacillus was isolated in most of them and examined as to its type—human or bovine. Wherever the primary lung lesion of Parrot was found, only bacilli of human type were obtained either from the lesion itself or from the glands in direct relation to it. Dr. Blacklock concludes from all the evidence that the pathway of infection in these cases has been by the air—all these children were infected through the air-passages by bacilli derived from other human beings. Investigations were also made on primary abdominal and surgical tuberculosis, and upon the significance of tuberculin reactions.

Clyde Bivalves.—Mr. A. C. Stephen (*J. Marine Biol. Ass. United Kingdom*, vol. 17, No. 1, 1932) has continued his investigations on the intertidal lamellibranchs of the Clyde, chiefly at Millport, and adds to his list certain forms living below low water mark, using the Robertson bucket dredge put through a 2 mm. sieve, with a check sample through a 1 mm. sieve. Four species are dealt with in the present paper—*Tellina tenuis*, *T. fabula*, *Abra alba* and *Cardium edule*. All these are important economically as fish food, *Cardium edule* (the common cockle) also as human food. *Tellina tenuis* extends to about 2½ fathoms but its growth is slower beyond low water mark than in any other part of its range, and the present results show that it is best adapted to life in the intertidal area. *T. fabula* extends from about low water mark to a depth of 10 fathoms. It grows rapidly, attaining a length of 4 mm. at the end of the first year, 8 mm. in the second and 10 mm. at the end of the third year. For both species the years 1926 and 1930 were exceptionally good for spat survival. It is found that after the disappearance or great thinning of any population, it is apparently renewed from spat, and the author is of the opinion that the clearing of the ground of adults as a result of high mortality after spawning or after unusual frost is the important factor for the survival of spat. Thus on the shore at the head of Loch Fyne, all the

cockles above low water mark were killed off by the severe winter of 1928–29, most of the present population being derived from the 1929 spat. The rate of growth in the cockle is greater at low water mark than farther up the beach. If it grows slowly in the first year it tends to lag behind always. Shells of the same length from higher levels are lighter than those from lower down.

Cultivation of *Catenaria*.—*Catenaria anguillulæ*, a chytridiacean fungus, has been found parasitic in the eggs of the liver-fluke of sheep (*Fasciola hepatica*), in the eggs of other helminthes and in small aquatic organisms. Evidence points to the tap-water in London and in Dublin as the source of infection of the eggs in the laboratory experiments. The cultivation of this *Catenaria* is recorded by J. B. Butler and A. Humphries (*Sci. Proc. Roy. Dublin Soc.*, vol. 20, No. 25, 1932) using various artificial media containing an aqueous extract of the eggs of the fluke with or without agar, and/or, egg albumen. In culture the development of mycelium was much more extensive than when the fungus was growing as a parasite. In one instance a single thallus produced more than twenty hyphal strands each bearing three to four sporangia. In another example more than 700 sporangia were present in a single outgrowth, possibly involving only one thallus. The more extensive development of the mycelium in artificial media supports the view that *Catenaria anguillulæ* is a form reduced through the influence of parasitism. Zoospores from the sporangia germinated on an artificial medium and produced a thallus, zoosporangia and zoospores. The variability of shape of the sporangia in culture and other points in the morphology are noted.

Digestive Enzymes in the Animal Organism.—As is well known, the digestive enzymes secreted in the animal organism pass into the urine, their presence therein furnishing a means of measuring the intensity of their formation and the activity of the digestive processes. In vol. 34 of the *Rendiconti della Reale Accademia delle Scienze dell' Istituto di Bologna* dated 1930 but only now just received, Prof. Pietro Albertoni describes experiments in which taka-diastase was injected into the blood of the dog. After the injection—into the jugular vein—the submaxillary saliva was examined and was found to be, as normally, devoid of diastatic properties. Stimulation of the chorda of the tympanum rendered the saliva denser but did not cause it to become diastatic. Hence the enzyme does not pass into the saliva, although it retains its physiological action since, injected into the blood, it determines mobilisation of the glycogen, producing hyperglucæmia. Thus, there is no question of a circulation of the digestive enzymes, which are absorbed but do not re-appear in the various secretions, and in all cases represent a specific product of the various glandular apparatus.

A New Method in Plant Taxonomy.—Kiichi Ohki appears to have given the 'spodogram' method of distinguishing species a very thorough examination in connexion with his studies of the Japanese Bambusaceæ, and does not appear dissatisfied with the method. The spodogram is obtained by taking a small piece of the leaf from the middle region and incinerating it carefully using a special apparatus first suggested by Werner (*Biologia Generalis*, 4, 1928). The ash when cool is mounted on a slide, with xylol and Canada balsam. In this way the outlines in particular of the epidermal cells are retained because of the silica contained in their walls. At first sight it would appear more reasonable, if such microscopic characters are to be used in taxonomy, to examine the full leaf tissue without resort to incineration, when the same characters together with others will be available for study, but the method of incineration certainly reduces the salient microscopic characters to a limited group, recognisable after incineration, which may be more simply treated in systematic study. Ohki's paper will be found in the *Journal of the Faculty of Science* (Tokyo, Section 3, Botany vol. 4, Part I).

British Basidiomycetæ.—Mr. Carleton Rea has re-published Appendix 2 to his book "British Basidiomycetæ" (*Trans. Brit. Mycol. Soc.*, vol. 17, Parts 1 and 2, pp. 35–50, 1932). The newly-described species belong to the genera *Pluteus*, *Lepiota*, *Psalliota*, *Amanita*, *Stropharia*, *Cortinarius*, *Inocybe*, *Tricholoma*, *Entoloma*, *Clitocybe*, *Hygrophorus*, *Flammula*, *Collybia*, *Leptonia*, *Mycena*, *Russula* and others. Many are uncommon or rare, but a few are common. Four new species and one new variety are described. These are *Psaliota floccosa* Rea, *P. impudica* Rea, *Leptonia acuta* Rea, *Clavaria griseola* Rea and *P. campestris* var. *squamulosa* Rea. Diagnoses of the five are given in Latin and English and they are illustrated upon an excellent coloured plate. Mr. Rea's "British Basidiomycetæ" is the most complete work which has appeared on the subject and it is most useful that the author should keep it up-to-date by the periodical descriptions of new species and varieties.

Heat Excluding Roofs.—In a paper on "Radiant Heat" read before the Institution of Heating and Ventilating Engineers on November 2, Mr. A. F. Dufton summarised the results which have been obtained at the Building Research Station on the relative merits of various forms of thin roofs as excluders of heat due to sunshine from the buildings they cover. Most roofing materials absorb about three-fourths of the sunlight that falls on them; for example, red tiles 67 per cent, blue slates 85 per cent, red asbestos tiles 74 per cent, old roofing lead 77 per cent, bituminised felt 89 per cent, galvanised iron when new 65 per cent, and when old and dirty 91 per cent. Whitewashing the upper surface of any one of these reduces the absorption considerably, for example, that of the dirty iron to 26 per cent. A glass roof under which the temperature was 188° F. when the temperature outside was 70° F. in the shade, when given two coats of whitewash on its top surface showed a temperature underneath of only 103° F. Mr. Dufton has not been able to detect that the rays from an incandescent electric light relieve the congestion of the nose produced by the radiation from an electric fire, although Sir Leonard Hill stated some time ago (*Times*, August 13) that they have this property.

Cosmic Radiation.—The issue of the *Physikalische Zeitschrift* for September 1 contains a valuable summary of our present knowledge of cosmic radiation with a long list of references, by Prof. Hoffmann of Halle. Systematic observations are now being made at Abisko, Königsberg, Potsdam, Innsbruck, Amsterdam, Dublin, Bandoeng and Cape Town, and each month new facts are discovered and new questions raised. After describing the electrometer, tube counter and Wilson chamber methods of

measurement, the author gives the principal results obtained. Curves of increase of the radiation with height in the atmosphere and of decrease with depth below the surface of water are given. With increase of barometric pressure the radiation decreases. It appears to come equally from all parts of the sky. The harder part of the radiation appears not to vary in amount with time but the softer part appears to be influenced by meteorological conditions in the atmosphere. The absorption of the radiation as it passes through matter is complicated by the production of corpuscular radiation. The question of variation of the radiation with position on the earth's surface is still unsettled, and much of the theory as to the origin of the radiation is speculative. (See also NATURE, 130, 570, Oct. 15, 1932.)

The Green Salt of Magnus.—The green compound of bivalent platinum obtained by Magnus in 1828 by the action of ammonia on platinous chloride is usually considered to be a complex salt $[Pt(NH_3)_4]$ $[Pt\,Cl_4]$, and a detailed X-ray examination published by Cox, Pinkard, Wardlaw and Preston (*J. Chem. Soc.*, Oct.) shows that this is the case, the four ammonia and chloride groups being arranged in a square about the platinum atom. A pink form also obtained is generally a different substance, namely, Cleve's salt, $[Pt(NH_3)_3Cl]_2$ $[PtCl_4]$, although in exceptional cases a pink orthorhombic form which is the true analogue of Magnus's salt is formed. It is suggested that, since the true pink salt of Magnus and Cleve's salt are convertible into the green salt, the transformation of Cleve's salt to Magnus's salt may take place by interchange of co-ordinated groups between anions and cations, and the ions of the Magnus salt would temporarily have a non-planar configuration. The pink salt may be this unstable form intermediate between the other two. The planar arrangement in the green salt of Magnus is analogous to that in K_2PtCl_4 and $[Pt(NH_3)_4]$ Cl_2, but in the latter the ammonia groups are rotating, whereas in Magnus's salt the evidence shows that they are not. This is no doubt due to the lower symmetry in the structure of the latter.

Astronomical Topics

Astronomical Notes for December.—Venus is still observable as a morning star, rising about $2\frac{1}{2}$ hours before sunrise, with five-sixths of its disc illuminated. Mercury is about 7° east of Venus in the latter half of December. Mars and Jupiter are observable after midnight; they are only 4° apart at the end of the month. This will be the last opposition of Jupiter in north declination for some years, so advantage should be taken of it. Mars is $1\frac{1}{2}$° north of Neptune on December 5. Uranus is still well placed for observation, in Pisces. It is stationary on December 28.

The winter solstice occurs at 1 A.M. on December 22.

The following are the times of the disappearances of stars occulted by the moon (as seen from London). ι Aquarii, December 3, 6^h21^m P.M.; μ Arietis, December 9, 11^h7^m P.M.; ρ Leonis, December 19, 0^h29^m A.M. (bright limb); the last star re-appears at the dark limb at 1^h25^m A.M., angle 331°.

A meteor radiant in the north of Gemini is sometimes active in the first half of December. Denning gave December 11 and 12 as the dates of maximum, but owing to moonlight, there would be a better chance some days earlier.

The most conveniently observable minima of Algol occur about 9 P.M. on December 16, and 6 P.M. on December 19.

The Leonid Meteors.—The weather in the London district was very unfavourable for observation on all the nights when meteors were expected. The only success reported in England is that of Mr. J. P. M. Prentice, the director of the meteor section of the British Astronomical Association, at Stowmarket; he recorded 20 Leonids between 5 and 6 A.M. on November 16; one of them was of magnitude − 3. The moon was so near that faint meteors would have been missed; moreover, there was a slight haze. Still, it is clear that if the earth had entered the dense part of the stream the number seen would have been much larger; if a great shower was seen anywhere, it was probably in the region of the Pacific Ocean, from which reports might be slow in reaching us. There is still a prospect of a rich shower next November; the great shower of 1866 was ten months after the perihelion passage of Tempel's comet. The moon will then be new.

Accelerations of Sun, Moon and Planets.—Dr. J. K. Fotheringham contributes a paper on this subject to the *Observatory* for November. He notes that it is now established that the solar and planetary fluctuations are correlated with the whole lunar fluctuation, not merely with the part that remains when the great empirical lunar term is excluded. The establishment of this fact facilitates the determination both of the individual fluctuations and of the secular accelerations, which cannot be deduced from modern observations until the fluctuations are known. The establishment of these preliminaries makes Mercury, on account of its rapid angular motion, the most suitable body for determining the solar and planetary accelerations. This and other lines of evidence lead to secular accelerations of 1·4″ and 4·8″ for the sun and moon respectively, the latter being in addition to 6·0″ for the La Place term (revised). The accelerations are proportional to the mean motions, except in the case of the moon. The value for the sun is confirmed, within narrow limits, by the independent researches of Prof. de Sitter, Herr C. Schoch, and Dr. Fotheringham. Thus results that were formerly the subject of much controversy may now be considered as fairly well established.

The ancient eclipses of sun and moon give the excess of the lunar acceleration over that of the sun, so that when either of these is found the other is deducible. Dr. Fotheringham announced at the meeting of the Royal Astronomical Society on November 11 that a portion of a tablet from Nineveh, which has been in the British Museum for many years, has now been deciphered with the aid of hints supplied by him. It proves to be a table indicating the manner in which the hours of day and night were reckoned. The day and night were each separately divided into six double hours, which consequently were not equal for day and night, but varied with the seasons. This clue will make it possible to improve the time determinations for the recorded eclipses of sun and moon, which may lead to a small revision of the values of the accelerations.

Imperial Cancer Research Fund*

THE tenth scientific report of the Imperial Cancer Research Fund is a substantial and profusely illustrated account of such of the researches carried out under the guidance of Dr. J. A. Murray as have not been published in the journals.

Five of the papers now published deal with the action of radium on tumours. The most important is by Dr. W. Cramer, who points out that a dose of radium radiation quite insufficient to kill cancer cells outside the body will often lead to the complete disappearance of growths to which it is applied *in situ* in the body. If a tumour irradiated in the body is after a few hours removed to another site in the same animal, it grows progressively. Hence, though radium has certainly some directly destructive effect on cancer cells, its main efficacy in curing tumours must be due to its action on the tissues of the host and so altering the surroundings of the tumour that it cannot survive. There is, as Miss Pullinger has also recently shown in human material, much damage to the blood vessels and also a great accumulation of leucocytes and other phagocytic cells, and it seems as if radium acts largely by encouraging the usually futile resistance which the tissues present to a growing tumour.

Dr. Cramer also shows that radium tends to inhibit or delay the carcinogenic action of tar. Dr. R. J. Ludford has analysed in detail the cytological effects of radium on a number of tumours, while Mr. Crabtree gives the results of an elaborate investigation of the influence of radium on the carbohydrate metabolism studied by Warburg's method. The results are negative in the sense that no difference was found between normal and malignant tissues, and glycolysis, specially characteristic of cancers, was in fact more affected than respiration. He has also examined the action of radium on the succinoxidase ferment of muscle

The other four papers, by Drs. Ludford and Foulds, are concerned with the reaction of tumours to vital staining with colloidal acid dyes. The chief results are that malignant cells do not segregate the dyes into their cytoplasm as normal cells do, and that the histiocyte series of phagocytic cells (which have a particularly intimate relation to vital stains) plays a substantial part in the resistance of the body to cancer, the details of which are at present not understood.

The thirtieth annual report of the Fund has also recently been issued. Among domestic affairs we notice with much regret that Sir Frederic Hallett has been compelled through ill-health to resign the post of secretary which he has occupied with such success since the foundation of the Fund thirty years ago. Appropriately enough, he is to be succeeded by Mrs. Harvey, daughter of the late Dr. E. F. Bashford, the first scientific director, who laid down the scope and objects of the Fund's investigations so well. The report also contains a very valuable summary by Mr. H. G. Crabtree of the present state of knowledge about Warburg's claim that the essential metabolism of the cancer cell differs from that of normal tissues. The claim has, on the whole, failed to stand the test of the voluminous investigations which it excited, but it has led to much interesting work and those who desire to know the situation as it stands at present cannot do better than consult Mr. Crabtree's account.

* Tenth Scientific Report on the Investigations of the Imperial Cancer Research Fund. Pp. viii+203+55 plates. (London: Taylor and Francis, 1932). 30s.

Electrical Units

SEVERAL of the many interesting papers presented to Section 2 of the International Congress of Electricity held in Paris last summer dealt with electrical units. Thirty years ago the general opinion prevailed that the realisation of the 'international' electrical units was much easier than that of the so-called 'absolute' units based on the c.g.s. system, but experience acquired in the last twenty years has considerably modified this view. H. L. Curtis, in Paper No. 4, discusses the various methods in use for the measurement of current in 'absolute' c.g.s. units, and urges the furtherance of investigations. The determination of the ampere in the c.g.s. system of units can at present be carried out with an accuracy probably higher than that attainable in the determination of the 'international' ampere by the deposition of silver.

E. Giebe, in Paper No. 3, writing on the determination of the ohm in absolute units, discusses four methods, of which two are in use at the National Physical Laboratory, one at the Physikalisch-Technische Reichsanstalt, and one at the U.S. Bureau of Standards; he concludes that "the accuracies of realisation of the absolute unit of resistance and of the mercury ohm are about equal," and adds: "the international mercury unit in use up to the present has decreased in importance, and could be discarded. This view was adopted in 1929 by the Comité International des Poids et Mesures, who on the recommendation of a committee of experts, decided to replace the international unit hitherto employed by the absolute unit, for technical as well as scientific purposes, and to accomplish the change as soon as a few more absolute measurements have confirmed our already accurate knowledge of the ratio of the two units."

Turning to the more technical papers, one by E. H. Rayner (No. 16) describes the electrostatic voltmeters and ammeters in common use at the National Physical Laboratory. The voltmeters, of the Kelvin multicellular type and all of the same range, are characterised by the lightness of the moving system, which weighs only 2·6 gm., although it comprises ten needles, a mirror and the damping device. Bifilar suspension secures great constancy of the zero point. The 130 volt range of the instrument is increased to about 40 kilovolts by resistance dividers, and to several hundred kilovolts by capacity dividers. The wattmeters are likewise made in one size only, have four quadrants and a single needle. "The three-electrode instruments used for measuring power and cognate magnitudes have been developed into wattmeters of a sensitivity and adaptability hitherto unattained by any other process. . . . A single instrument of each kind (voltmeter and wattmeter) with auxiliary apparatus consisting mostly of precision resistances, renders possible the measurement of almost all

electric magnitudes at power frequencies, with a range of sensitivities and an accuracy which it would be very difficult to obtain by other means."

N. E. Dorsey summarises and discusses, in a paper of general interest (No. 10), the results of the most important determinations of the velocity of light, of the ratio of the electromagnetic to the electrostatic unit of electricity, and of the velocity of propagation of Hertzian waves. He concludes that experiment confirms modern electromagnetic theory in regarding the results as being determinations by three different methods of one and the same quantity, and gives 299,792 kilometres per second as the most probable value. Dorsey directs attention to the apparently systematic decrease in the values obtained for the velocity of light during the last fifty years, but does not agree with Gheury de Bray that the fact indicates an actual decrease in the value of *C*, for, quoting from comments on the subject which appeared in these columns (NATURE, 120, 594, Oct. 22, 1927): "An absolute change in the velocity of light . . . could scarcely obtain acceptance unless supported by much more decisive observational material."

Engineering Methods in Optical Manufacture

MR. WILLIAM TAYLOR'S valuable presidential address on October 28 to the Institution of Mechanical Engineers gave a very illuminating résumé of the modern methods of photographic lens manufacture in use in the famous Leicester factory of Messrs. Taylor, Taylor and Hobson, Ltd., and of a number of original methods which are the fruit of his own genius as an engineer. Amongst these innovations may be mentioned the tubular cutter for lens blanks, the annular carborundum wheel for roughing, improved fine-grinding and polishing machinery with an automatic supply of rouge and water, and special machines for edging. The description of these, published in the *Proceedings* of the Institution, will well repay reading by all interested in methods of optical manufacture or allied processes.

It is at first sight surprising, as the address hints, to find very primitive methods still surviving in some optical workshops, and this in spite of all that modern engineering and mass production methods can achieve. It is no slight on Mr. Taylor's originality to remind ourselves that Robert Hooke suggested, nearly three hundred years ago in the preface to his "Micrographia", the use of the grinding wheel on an inclined adjustable axis for producing curves of any required radius, for there is a long step between the geometry of the method and its successful application in practice. It has to be recognised, too, that operations and machines which can be worked successfully in a large factory for more or less continuous production are beyond the scope of a smaller concern where the optical work, though important, does not justify the installation of any but essential machinery.

The logic of the mass production thesis is the concentration of production in a few centres; the problem which it brings is the fair distribution of the wealth created, both in the form of goods and leisure. The mainspring of the whole movement in mechanisation is, as Mr. Taylor implies, the ever-present urge to overcome physical limitations of all kinds. In itself, this is one of the most excellent of human aspirations, and the spirited defence of mechanisation which forms the closing part of the address is unanswerable, provided that mankind is educated up to the duties which its privileges involve. But since our ethical and political development is so slow, we may sometimes tremble lest over-quick rationalisation should produce a condition beyond our power to control.

Apart from considerations of this kind, it is unlikely that optical manufacture has yet reached a finally definitive stage; we may speculate, however, as to whether future advances will consist in a slow progress in matters of detail, or whether some leading invention will render possible the production at will of non-spherical surfaces of prescribed form and optical accuracy. This latter is, indeed, no new problem. Food for thought will be found in the theoretical work on the subject dating from the time of Descartes, and the practical experiments of Fraunhofer, Bessemer, Parsons, and others. Optical accuracy has not been attained, but our command over physical processes is growing, and grinding is not the only method of producing surfaces of required form.

Mr. Taylor has shown us that progress can still be made by courageous attack, and we should ask for nothing better than to venture forward.

L. C. M.

New Gaseous Lamp

ON November 15 at a special meeting of the Illuminating Engineering Society held at the Wembley Laboratories of the General Electric Company, Ltd., Mr. C. C. Paterson read a paper on luminous discharge tube lighting. He pointed out that the current through the discharge tubes does not follow Ohm's law. It varies in a complicated way with the pressure of the gas inside the tube, the apparent resistance diminishing as the current increases.

The new discharge tubes were suggested by Pirani in Berlin and by the General Electric Company of America. They make use of the experimental fact that if the cathode is heated to a temperature at which it will emit electrons freely, the voltage fall at the cathode will be greatly reduced and so large currents can be passed without serious sputtering taking place. The electrodes of these tubes or 'gaseous lamps' consist of alkaline earth oxides which can be heated electrically like small filaments. With the use of these electrodes the cathode fall is only about twenty-five volts. The current therefore can be thirty or even a hundred times as large as that obtainable with ordinary cold cathodes, being only limited by the heat developed by the discharge. The pressure of operation is so small that it can be obtained from any ordinary electric supply. The gas or vapour inside the gaseous lamp must emit a suitable spectrum and it must not decompose under the action of the discharge.

There are several other conditions the tube must fulfil. It has been found that a white light can be obtained from a neon tube provided a definite small

quantity of mercury vapour is present. It is not possible to mix a number of gases and vapours in one tube as each gas requires a definite voltage to stimulate it. It is not possible, for example, to harness a mixture of mercury and sodium vapour and neon gas in the same tube and so combine them to obtain a suitable radiation.

The fire-fly restricts its radiation to the visible spectrum only, whilst in the ordinary lamp a large proportion is emitted in the infra-red. The former is consequently an extremely efficient light source. If all the energy supplied to a discharge tube were emitted at a wave-length of 5,550 A., corresponding to the peak of the luminosity curve of the eye, the luminous efficiency would be about 670 lumens per watt. Compare this with the 12 lumens per watt of a 100 watt incandescent lamp. In practice it is now possible to make 100 watt sodium lamps with an efficiency of 70 lumens per watt. If the internal losses in the tube were negligible, theory shows that the efficiency would be 360 lumens per watt. Pirani has obtained this efficiency in the laboratory but it is impossible, as yet at least, to obtain it in a commercial lamp.

The development of gaseous lamps has been taking place rapidly during the last year. By placing neon and mercury tubes in parabolic reflectors, very efficient lamps suitable for flood-lighting are obtained. A 400 watt lamp is being developed at Wembley which seems very suitable for lighting streets and important thoroughfares. The street outside the Wembley Laboratories was shown illuminated in this way with very satisfactory results. Some people might find difficulty in distinguishing a 1*d*. stamp from a 1½*d*. stamp by the light from these lamps. Sodium lamps were developed first by Pirani in Berlin. There is a section of road admirably lighted by these lamps in Holland and another in Zurich. A similar lamp developed at Wembley is being tried for lighting stretches of arterial and country roads where the lack of good colour discrimination is of little importance.

Many avenues of research in connexion with gaseous lamps are still unexplored. It seems certain that their colour will soon be improved and that their efficiency will be very appreciably increased.

Industrial Research and National Problems

SIR FRANK SMITH, secretary of the Department of Scientific and Industrial Research, delivered the Norman Lockyer lecture of the British Science Guild on November 22, taking as his subject "Industrial Research and the Nation's Balance Sheet". Sir Arnold Wilson was in the chair.

Sir Frank Smith urged that the active prosecution of industrial research is essential for improving Great Britain's national balance sheet, which in the past ten months has shown an *apparent* adverse balance of some £263,749,000. To go on paying its way, it is necessary for British manufactured products upon which, together with its invisible exports, depends its ability to pay for imports, to continue to be as good or better than those of its competitors, while at the same time prices must not be higher. To this end, increased mechanisation and increased use of knowledge are necessary and "it is essential that the floodgates of international trade should be opened and that some measure of stability and freedom should be given to currency systems". These topics are discussed whenever men meet, but not so often do we hear of the necessity of financing industrial research, without which we shall fail to sell many of our products. "If a country had to choose between new knowledge and gold . . . the wise choice would undoubtedly be new knowledge for with it the gold can be obtained whereas without it the gold will be lost."

One hundred years ago there was no such thing as organised industrial research, and progress depended either on isolated research of men of genius or on accidental and unrelated observations. Later, in the nineteenth century, scientific men at the universities were occasionally asked to solve some of the problems of industry, but with the growth of the electrical, chemical and metallurgical industries, which depend on science for their very life, our industrial research laboratories came into being. "These laboratories aim at preventing industrial waste, at the standardisation of processes of manufacture and of the products, at lessening the costs of production and at the production of new types of goods. Their work does not replace the pure research work carried out at the Universities. It is supplementary to it. The outstanding characteristic of pure research is that it aims at increasing knowledge irrespective of application and it cannot be organised in the same way as industrial research. As Sir Joseph J. Thomson has said, 'Great ideas in science are as wayward as the fancies of a poet, and they cannot be controlled and organised.' "

Though industrial research has made great headway in Great Britain and the greatest and most successful undertakings have research laboratories of their own, this country is in many respects still doing less than some of its competitors; "there is with many industries far too much timidity and hesitation, and these must be overcome if this country is to retain much of our old-time supremacy in manufacture and export more manufactured goods."

Referring to the scheme for co-operative industrial research associations initiated by the Department of Scientific and Industrial Research in 1918, Sir Frank stated that there are now more than five thousand firms connected with the twenty research associations which have been set up. These firms have contributed about one and three-quarter millions to the cost of the work carried out. An investigation carried out by H.M. Chief Inspector of Factories covering nearly 128,000 factories employing about five million workers showed that less than five hundred of these factories employed more than one thousand workers each, while 117,147 factories employed less than one hundred workers each. It is well to urge that "industrial firms should build research laboratories, but it is obvious that not one of these 117,147 firms can take an effective part in industrial research as an isolated unit. . . . Co-operative research is the only solution to the problem of applying science to small units."

Sir Frank Smith then proceeded to consider the relations between research and the national balance sheet, in the case of Great Britain's largest import, food-stuffs; its greatest material asset, buildings; and its greatest natural asset, coal. He pointed out that the scientific study of refrigerating devices, which not so long ago were, like the photoelectric cell, mere toys of the laboratory, together with the

investigation of the biological problems involved in the transport and storage of foodstuffs, are doing much to help the national balance sheet by reducing imports through preventing waste.

In industrial processes care is taken to keep wear and tear of plant at a minimum and to design plant which is not likely to be obsolete, in such a way that replacement costs are comparatively small. The nation's most valuable plant is in the form of buildings, the value of which is estimated by Sir Frank at £4,500,000,000. Here science is helping by better planning and construction and by showing the builder how to choose his materials to greater advantage.

In the case of coal there are four ways in which research can help the trade balance: first by mechanising still further the hewing of coal and increasing the use of machinery in mines, thereby increasing our production power; secondly, by discovering means of obtaining more units of useful power from the fuel burnt; thirdly, by better marketing made possible by the application of the results of a scientific and comprehensive survey of our coal resources now being carried out; and fourthly, by the discovery of new and better methods for converting coal into powder, liquid and gaseous forms and the full utilisation of these forms.

University and Educational Intelligence

BRISTOL.—The annual Henry Herbert Wills memorial lecture will be delivered on December 15 at 5.15 P.M. in the Wills Laboratory by Lord Rutherford. The title of the lecture will be "Atomic Transformations". Admission will be by ticket obtainable from the Secretary.

LEEDS.—The honorary distinction of emeritus professor has been conferred upon Profs. F. W. Eurich, C. M. Gillespie, and R. S. Seton, who recently retired from the chairs of forensic medicine, philosophy and agriculture respectively.

LONDON.—The following degrees have recently been awarded: D.Sc. degree in biochemistry to Prof. E. C. Dodds (professor of biochemistry at Middlesex Hospital Medical School) for published papers on hormones, supported by 42 other papers and 3 books; D.Sc. degree in botany to Helen Kemp Archbold (Imperial College—Royal College of Science and Bedford College) for a thesis entitled "Ripening Processes in the Apple and the Relation of the Time of Gathering to the Chemical Changes in Cold Storage" (*Ann. Bot.*, July, 1932); D.Sc. degree in chemistry to Mr. J. R. I. Hepburn (East London College and Northern Polytechnic) for five published papers on "The Vapour Pressure of Water over Aqueous Solutions of Inorganic Electrolytes", and Ramsinha Thakur (Imperial College—Royal College of Science) for a thesis entitled "Three-Carbon Tautomerism in Dicyclic Systems"; D.Sc. degree in physics to Mr. J. H. Jones (King's College) for a thesis entitled "The Diffraction of Elastic Waves at the Boundaries of a Solid Layer Embedded in a Medium Possessing Lower Elastic Wave Velocities" (*Proc. Roy. Soc.*, A., 1932); D.Sc. in chemistry to Mr. B. S. Evans for twelve independent published works in inorganic analytical chemistry, together with four conjoint subsidiary contributions.

A STATEMENT for the academic year 1931–32 has been issued by the Rhodes Trust, Seymour House, Waterloo Place, London, S.W.1, from which it appears that, during the year, 71 Rhodes scholars took up their scholarships at the University of Oxford for the first time. The total number of scholars in residence during the year was 196, comprising 103 from the British Empire, 89 from the United States and 4 from Germany. Classifying the scholars by the subjects read, there are 42 taking natural science and medicine, 7 mathematics and 2 forestry.

THE annual conference of the Geographical Association will be held at the London School of Economics, Houghton Street, Aldwych, W.C.2, on January 4–6, and at the Imperial Institute, South Kensington, on January 7. The presidential address will be delivered by Dr. H. R. Mill on "An Approach to Geography" on January 4. Among the lectures to be given at the Conference are: Mr. J. M. Scott: "The British Arctic Air Route Expedition, 1930–31"; Mr. G. Huxley: "The Work of the Empire Marketing Board"; the Right Hon. Lord Meston: "Contrasts in the Ganges Basin"; Prof. Kenneth Mason: "The Exploration of the Himalaya"; Prof. R. G. Stapledon: "Climate and the Improvement of Hill Grazings"; and Sir John Russell: "Modern Changes in the Sources of our Food Supplies". Further information can be obtained from the Clerk, Geographical Association, Municipal High School of Commerce, Princess Street, Manchester.

Calendar of Geographical Exploration

Nov. 28, 1605.—Discovery of Australia

Willem Janszoon of Amsterdam sailed in the *Duifken* from Bantam, Java, hoping to discover more about New Guinea. He reached the coast of New Guinea in lat. 5° S. and followed the shore round Prince Frederick Henry Island to the beginning of Torres Strait. Thence he steered south and traced the eastern shores of the Gulf of Carpentaria to 13° 45′ S. Janszoon thought the coast was part of New Guinea. Attempts to open up trade with the sparse groups of natives failed, nine of the crew being murdered by them. The Spanish, under Torres, in the 1605–7 expedition discovered the true nature of Torres Strait, but not until 1762 was this realised, for Spain was then entering on a period of decadence and the results of the voyage were overlooked. Whatever vague reports of a southern land may have existed before the voyage of the *Duifken*, Janszoon's exploration of the Gulf of Carpentaria forms the first record of the discovery of Australia.

Dec. 3, 1738.—La Vérendrye and his Sons

Pierre Gaultier de Varennes, Sieur de la Vérendrye, reached a Mandan village, after having for the first time in this latitude crossed long. 100° W. La Vérendrye began his famous career of exploration in Canada in 1726, constantly aiming at reaching the Pacific Ocean. In this he failed, but on his last journey (1738) he accomplished more than half the distance between Montreal and the Pacific. To him and to his sons is due the pioneer opening of the beginning of that route west of Winnipeg along which the Canadian Pacific Railway afterwards went. The La Vérendryes discovered Lake Manitoba, explored the Saskatchewan to the junction of the two main branches and established many forts. La Vérendrye's eldest son was killed in 1738 by Indians, but the other two in 1742 set out with Mandan guides and reached a mountain range with snow-clad peaks, probably the Rookies, though possibly the Bighorn Mountains.

Societies and Academies

LONDON

Royal Society, Nov. 17.—A. Michels and C. Michels: The influence of pressure on the dielectric constant of carbon dioxide up to 1,000 atmospheres between 25° C. and 150° C. The method used was in principle the heterodyne beat—one with a frequency of 508 kilocycles. By special arrangements it was possible to keep the beat note constant for long periods within 1 frequency per second. The dielectric constant varied between 1·0009 and 1·73. The accuracy obtained was ± 0·00035. The Clausius-Mosotti expression has been calculated below 100° C., and for pressures above 100 atm., as only in this region are there sufficient compressibility data. Owing to the accuracy of these latter, the accuracy of the Clausius-Mosotti expression is limited to one half per cent. The values found do not change with temperature by an amount greater than this figure, but show a tendency to decrease with increasing pressure.—**E. N. da C. Andrade and B. Chalmers:** The resistivity of polycrystalline wires in relation to plastic deformation and the mechanism of plastic flow. The specific resistance of metals which crystallise in the cubic system is unaffected by plastic flow, but for those which crystallise with a unique axis of symmetry it changes during the intermediate of the stages. For some metals the change is an increase, for others a decrease, the difference of sign being explicable in terms of the orientation of the slip planes in relation to the crystalline structure of the metal, supposing that there is rotation of the crystallites during the stage of the flow in question. At liquid air temperature the sign of the change of resistance of cadmium reverses, an effect which can be traced to the heavy twinning which takes place under stress at this temperature, as against distortion by glide at higher temperatures. A general result is that, in the cases investigated, the electrical resistance of a polycrystalline wire can be simply explained in terms of the resistance of the single crystals.—**R. O. King:** The beneficial effect of oxidation on the lubricating properties of oil. Experiments were made in conditions promoting oxidation of the lubricating oil and at constant speed and load. Friction in the circumstances falls as the temperature is raised, and generally passes through a minimum value (μ min.) at a temperature somewhat less than that of seizure (S.T.); lubricating value or performance is represented by the observed values of μ min. and S.T., which for a typical blended mineral oil were 0·0010 and 158° C., respectively at the beginning of oxidation. Viscosity increased with oxidation, but the consequent increase of fluid friction was apparent at temperatures below 50° only; at higher temperatures it decreased with the progress of oxidation and S.T. rose. Thus after about sixty hours of oxidation, μ min. diminished to 0·00045 and S.T. exceeded 300° C. The oil in a state of partial combustion remained an effective lubricant, μ being less than ever recorded for fluid friction, even with air as the lubricant. It is suggested that the active or polar molecules formed during the early stage of oxidation build up to an appreciable thickness on the adsorbed layer, and the friction observed is that on the surface of the built-up layer. The surface diminishes in rigidity in the direction of motion as the thickness of the boundary layer increases, and friction approaches zero as a surface of complete slip tends to be reached.

Physical Society, Nov. 18.—T. C. Sutton: The measurement of surface tension. A convenient method is described for measuring simultaneously the surface tension and the density of a sample of liquid. A few milligrams of liquid will suffice. The method has advantages, therefore, for the measurement of the parachors, $\gamma^{\frac{1}{4}}\rho$, of rare liquids. Volatile liquids may be used.—**L. G. Grimmett:** A sensitivity-control for the Lindemann electrometer. A circuit is given for varying the sensitivity of the Lindemann electrometer by means of one adjustment only.—**B. Lloyd-Evans and S. S. Watts:** An investigation into the flow of air in pipes. The authors examine the researches of Ombeck on the flow of air through cylindrical pipes. They obtain an expression which represents in a convenient form the phenomena that occur in a smooth-bore pipe. In particular, they separate the effects of acceleration of the gas from those of friction, and express the latter in terms of the equation suggested by Lees to fit Stanton's curve. Their results appear to justify the researches of Lees and Stanton, rather than the analysis made by Ombeck of his test figures.—**Mary D. Waller:** Vibrations produced in bodies by contact with solid carbon dioxide. Conditions under which very loud notes may be produced and maintained for a considerable time in metal objects capable of vibration, such as tuning forks, bars, discs, rings, and tubes, when brought into contact with a solid carbon dioxide block are described. Notes have also been sustained in quartz crystals. The vibration frequencies normally excited may range from about 1,000 to 15,000 ~. Lower frequencies have been excited in wires. Surface tension ripples may be produced on mercury. The vibrations are only produced by solid carbon dioxide of high density. The source of energy for producing the vibrations is the heat given up by the metal to the solid carbon dioxide.

PARIS

Academy of Sciences, Oct. 17 (vol. 195, pp. 633–684).—**Camille Matignon:** Injurious fogs. Referring to the fatal fog in the Meuse valley in December 1930, attention is directed to a noxious fog, also in the Meuse valley, which occurred on January 4, 1800, and observations of a contemporary observer are quoted.—**Maurice Fréchet:** The most general continued solution of a functional equation of the theory of probabilities in chain.—**Alfred Rosenblatt:** The unicity of solutions of partial differential equations of the first order.—**Paul Montel:** A class of meromorph functions.—**A. Toussaint and H. Girerd:** Comparison between the wall corrections in blowers of rectangular section and circular section.—**Ch. Sadron:** The standardisation of a blower for low velocities. For low velocities, less than 15 cm. per sec., the air current carrying smoke shows a curious phenomenon: the smoke thread splits up, the heavy parts fall out in drops and the interval between these drops is constant and is proportional to the air velocity. Hence this phenomenon can be utilised to measure the velocity of a very slow air current.—**Jacques Métadier:** The study of the Brownian movement in a field of force.—**A. da Silveira:** The Raman effect in solutions of cupric salts. From a comparison of the Raman spectra of solutions of copper sulphate and copper nitrate, the lines due to the sulphate ions and nitrate ions are distinguished.—**F. Wolfers:** Remarks on the Mach effect. A discussion of a recent paper by Demetrovic; analogous effects can be observed with X-rays.—**J. Thibaud and**

F. Dupré la Tour: The weakening of the nuclear radiation of beryllium in material screens.—**Auguste Le Thomas**: The influence of high proportions of silicon on certain properties of cast irons. The silicon varied from 1·1 per cent to 10·4 per cent and measurements are given of hardness, transformation temperatures, and temperatures of graphite formation.—**René Dubrisay and Guy Emschwiller**: The oxidation of iodoform solutions. Solutions of iodoform in benzene undergo rapid oxidation in daylight, with production of iodine, carbon monoxide and dioxide, but remain unchanged in the dark. After the addition of iodine and hydriodic acid, such solutions are oxidised in the dark. Oxidation differs with different solvents, and is sensitive to the presence of impurities in the solvent.—**Seailles**: The action of media with alkaline reaction on the crystallisation of the calcium aluminates and on the setting of aluminous cements. The alkalinity of the medium, defined by the hydrogen ion concentration, determines the form and the nature of the hydrated calcium aluminates which are formed starting from the anhydrous aluminates. This alkalinity causes the same phenomena and is independent of the nature of the base.—**Paul Bary and Emile Fleurent**: The influence of oxygen on the degradation of solutions of caoutchouc. The viscosity changes in rubber solutions brought about by rise of temperature are sensitive to the presence of traces of oxygen. In the absence of oxygen the change of viscosity is a hyperbolic function of the time.—**Jacques Bourcart**: The presence of a large crocodilian in the Miocene glauconitic molasse of El Kansèra and its stratigraphical signification. The bones found resemble those of *Dyrosaurus phosphaticus* but further work is necessary for the full identification.—**Georges Denigès**: The action of iodine on sea waters.—**V. Frolow**: The periodicities of the rises and falls of the Nile. A graphical study of the data available, Arabian from A.D. 621 until 1433, restarting during the eighteenth century for high water, and low water from 1838. The amplitude of the floods has become greater in modern times owing to the embankment of the Nile.—**H. des Abbayes**: Observations on the lichens of the neighbourhood of Banyuls (Eastern Pyrenees).—**R. Hovasse**: The Podamphora stage and the Ebriaceæ. The skeleton of *Podamphora Elgeri* has been regarded by A. Deflandre as arising from two different organisms: the author gives reasons for not agreeing with this view.—**André Chevallier, Jean Guillot and Pierre Chabre**: The ultra-violet absorption of certain plant and animal oils.—**G. Guittonneau and J. Keilling**: The formation of higher polythionates in the course of the solution of elementary sulphur in the soil. In addition to pentathionates described in an earlier paper, tetrathionic acid has now been isolated as the sodium salt. Thiosulphates are present in traces only.—**J. Cheymol and A. Quinquaud**: Serocalcemia and the kidney. On leaving the kidney the blood contains less calcium. After ablation of the kidney there is a temporary elevation of the proportion of calcium in the blood.

ROME

Royal National Academy of the Lincei, June 3.—**U. Cisotti**: Double tensors with a single divergence.—**B. Caldonazzo**: Hemisotropic quintuple tensors.—**J. Capoulade**: Frontier arcs rendered non-proper by the singularities of the coefficients in Dirichlet's problem for equations of the second order and of elliptic type with two variables.—**L. Fantappiè**: New demonstration of the fundamental formula for linear analytical functionals.—**L. Geymonat**: An observation on a theory of Carathéodory for harmonic functions.—**M. Picone**: Majoration of the error of approximation in the Cauchy–Lipschitz method of integrating systems of ordinary differential equations.—**O. Franceschi**: Projective study of the interior of a surface.—**M. Pascal**: Motion of a deformable body which remains similar to itself. (1) Fundamental formula and properties deduced therefrom. Abramescu's recent kinematic study of the motion of a deformable body which remains similar to itself was limited to the case of a plane body. The results obtained on extending this study to a three-dimensional body are now outlined.—**A. Kolmogoroff**: The general form of a homogeneous stocastic process.—**A. Occhialini and G. Melchiori Ranghiasci**: A simplified method for the photographic measurement of the length of spectral lines. This method consists essentially in subjecting both lens and film-holder to a succession of sudden displacements so as to obtain a number of separate images of the spectrum.—**G. A. Barbieri and A. Tettamanzi**: Contribution to the knowledge of compounds of divalent chromium. The following complexes of chromous compounds with organic bases, representing new types of chromous compounds, are described: (1) Chromodipyrridyl bromide, $[Cr^{II}(C_{10}H_8N_2)_3]Br_2, 6H_2O$, isomorphous with, and similar in chemical behaviour to, ferrodipyrridyl bromide; (2) chromous hexamethylene thiocyanate, $Cr(SCN)_2, 2(C_6H_{12}N_4.HSCN)$, and (3) chromous hexamethylene chloride, $Cr\,Cl_2, 2HCl, C_6H_{12}N_4, 4H_2O$, which belongs to an entirely new saline type; ferrous, nickel, cobalt, and manganous compounds analogous to compound (3) have also been obtained.—**O. Bottini**: Influence of exchange cations on the capillary rise of water in the soil. In one and the same soil saturated with different cations, water ascends with different velocities. This phenomenon is due principally to the part played by the exchange cations in determining and adjusting the mutual relationships between water and soil, and in particular to the influence of such cations on dispersion and swelling. In this respect the cations are arranged according to a progression which is not difficult to recognise for the lyotropic series and for the hydration series.—**Giselda Serra**: A new species of *Schizaster*. A specimen, of unknown age and origin, found in the echinoid collection of the Palæontological Institute of the University of Rome, is named *Schizaster Portisi* n. sp.—**Fausta Bertolini**: The autotomy of the digestive apparatus and its regeneration in *Holothuria*, as a spontaneous and normal phenomenon.—**T. Terni**: The development of the fin of Urodeles, on the basis of morphological and experimental investigations.—**Giulio Cotronei**: Heart transplantations between Anura and Urodeles.—**Z. Szantroch**: Investigations on intracellular fatty substances in various tissues cultivated *in vitro*. The results obtained confirm those of Kaufmann and Lehmann and indicate that neither the Ciaccio method nor the Smith–Dietrich method allows the group of substances usually known as lipoids to be distinguished with certainty from glycerol esters.—**U. D'Acona**: Does striated muscle-fibre change in volume during contraction? Micro-cinematographic investigation of muscular contraction fails to disclose any reason for assuming variations in volume of the contracted muscle fibre as a whole. It appears to prove, however, that the separate strands of the fibre widen and increase in volume at the commencement of the contraction, that they next shorten (to about forty per cent of the original length) and diminish in volume,

and that they finally resume the initial length and volume. The de-contraction takes place far more slowly than the contraction. During the passage of the contraction wave, the inter-fibrillar spaces broaden either by longitudinal displacements of liquid or by disimbibition of the fibrils.

Forthcoming Events

SATURDAY, Nov. 26

UNIVERSITY OF CAMBRIDGE, at 5—(Henry Sidgwick Memorial Lecture in the College Hall, Newnham College).—Sir James Jeans: "The Farthest Depths of Space".

MONDAY, Nov. 28

ROYAL GEOGRAPHICAL SOCIETY, at 5.30—The Rev. J. W. Arthur: "Kilimanjaro and Kenya".

ROYAL SOCIETY OF ARTS, at 8—(Fothergill Lecture).—Lieut.-Col. Guy Symonds: "Safety of Life from Fire".

TUESDAY, Nov. 29

ROYAL INSTITUTION, at 5.15—Prof. Lancelot Hogben: "Colour Change in the Animal Kingdom" (succeeding lectures on Dec. 6 and 13).

WEDNESDAY, Nov. 30

FOLK-LORE SOCIETY, at 8—(at University College, Gower Street, W.C.1).—Prof. John Read: "Alchemy and Alchemists".

THURSDAY, DEC. 1

CHADWICK PUBLIC LECTURE, at 8—(at the Royal Sanitary Institute).—Dr. T. Carnwarth: "Public Health Administration".

BROWN INSTITUTION LECTURES, at 5—(at the London School of Hygiene and Tropical Medicine).—Prof. F. W. Twort: "Bacteria in Nature".

UNIVERSITY OF BIRMINGHAM, at 5.30—(Huxley Lecture).—Sir Arthur Salter: "Next Steps in World Recovery".

BRITISH PSYCHOLOGICAL SOCIETY, at 8.30—Discussion on "Adaptation and Fatigue", to be opened by Prof. F. C. Bartlett.

FRIDAY, DEC. 2

ROYAL INSTITUTION, at 9—Marchese Marconi: "Radio Communications by Means of Very Short Electric Waves."

INSTITUTION OF MECHANICAL ENGINEERS, at 6—(Thomas Lowe Gray Lecture).—E. F. Cox: "Eight Years' Salvage Work at Scapa Flow".

NATIONAL CONFERENCE ON THE PLACE OF BIOLOGY IN EDUCATION, Nov. 30 and Dec. 1 and 3—(at British Medical Association House, London, W.C.1).—The Right Hon. Viscount Chelmsford (Presidential Address) on Nov. 3 at 11.

INTERNATIONAL SOCIETY OF LEATHER TRADES' CHEMISTS (BRITISH SECTION), Dec. 1, at 10—(at the Leathersellers' Hall, St. Helen's Place, Bishopsgate, E.C.3).—Conference on "The Swelling of Proteins". Introductory address by Prof. F. G. Donnan.

Official Publications Received

GREAT BRITAIN AND IRELAND

Journal of the Society of Glass Technology. Edited by Dr. W. E. S. Turner. Vol. 16, No. 63, September. Pp. x+251-374+291-394+xxiv. (Sheffield.) 10*s.* 6*d.*

Proceedings of the Cambridge Philosophical Society. Vol. 28, Part 4, 31st October. Pp. 403-562. (Cambridge: At the University Press.) 7*s.* 6*d.* net.

Imperial Bureau of Animal Genetics. The Physiological and Genetical Aspects of Sterility in Domesticated Animals. By William Orr and Dr. F. Fraser Darling; with a Bibliography by Miss M. V. Cytovich. Pp. 80. (Edinburgh and London: Oliver and Boyd.) 2*s.* 6*d.*

University College of North Wales. Calendar for Session 1932-33. Pp. 446. (Bangor.)

County Council of the West Riding of Yorkshire: Education Committee. Report on the Examination for County Minor Scholarships, 1932. Pp. 42. (Wakefield.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1482 (E.F.317): Relative Temperatures of Brass when subjected to Reversed Direct Stress in Vacuo and in Air. By Dr. H. J. Gough and D. G. Sopwith. Pp. 4+2 plates. (London: H.M. Stationery Office.) 4*d.* net.

Proceedings of the Royal Society. Series A, Vol. 138, No. A835, November 1. Pp. 259-478. (London: Harrison and Sons, Ltd.) 11*s.*

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1932; with Appendices. Pp. 45. (London: H.M. Stationery Office.) 9*d.* net.

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 2, No. 12: Scottish Carboniferous Ostracoda. By Mary H. Latham. Pp. 351-395. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 6*s.*

University of Cambridge: Solar Physics Observatory. Twentieth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1931 August 1—1932 July 31. Pp. 4. (Cambridge.)

The University of Liverpool. Publications of the Hartley Botanical Laboratories, No. 8: Studies of Flowering in Heterostyled and Allied Species. Part 1: The Primulaceæ. By James Stirling. Pp. 42. (Liverpool: University Press of Liverpool.)

OTHER COUNTRIES

United States National Museum. Bulletin 164: The Canadian and Ordovician Formations and Fossils of South Manchuria. By Riuji Endo. Pp. iii+152+40 plates. (Washington, D.C.: Government Printing Office.) 50 cents.

N.Z. Department of Scientific and Industrial Research. Apia Observatory, Apia, Western Samoa: Annual Report for 1930. Pp. iv+71. (Wellington, N.Z.: Government Printing Office.) 4*s.*

Journal de la Société des Américanistes. Nouvelle Série, Tome 24, Fasc. 1. Pp. 220. (Paris: Société des Américanistes.) 60 francs.

Ministère de l'Instruction publique et des Beaux-Arts. Enquêtes et documents relatifs à l'enseignement supérieur, 126: Rapports sur les Observatoires astronomiques de Province et les Observatoires et Instituts de Physique du Globe, année 1930. Pp. 145. (Paris.)

Society of Biological Chemists, India. Some Aspects of Plant Nutrition. By B. Viswa Nath. Pp. ii+39. (Bangalore: Indian Institute of Science.) 1 rupee.

The Victorian Bush Nursing Association. Report and Statement of Accounts to 30th June, 1932. Pp. 202. (Melbourne.)

Department of Agriculture, Straits Settlements and Federated Malay States. General Series, No. 10: Insects of Coconuts in Malaya. By G. H. Corbett. Pp. iv+106+19 plates. (Kuala Lumpur.) 1.50 dollars.

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 4, No. 9-10, Septembre-Octobre. Pp. 377-472. (Prague: Regia Societas Scientiarum Bohemica.)

Forest Bulletin No. 77: The Identification of Important Indian Sleeper Woods. By K. A. Chowdhury. Pp. v+18+30 plates. 3 rupees; 5*s.* 3*d.* Forest Bulletin No. 78: The Problem of the Pure Teak Plantation. By H. G. Champion. Pp. iii+38+2 plates. 12 annas; 1*s.* 3*d.* (Calcutta: Government of India Central Publication Branch.)

The Indian Forest Records. Vol. 17, Part 3: Immature Stages of Indian Coleoptera (11) (*Platypodidæ*). By J. C. M. Gardner. Pp. ii+12+2 plates. (Calcutta: Government of India Central Publication Branch.) 9 annas; 1*s.*

Memoirs of the Geological Survey of India. Palæontologia Indica. New Series, Vol. 20, Memoir No. 1: New Fossils from the Agglomeratic Slate of Kashmir. By Dr. F. R. Cowper Reed. Pp. v+79+13 plates. 8.4 rupees; 14*s.* New Series, Vol. 20, Memoir No. 3: A Petrified Williamsonia (*W. Sewardiana*, sp. nov.) from the Rajmahal Hills, India. By Prof. B. Sahni. Pp. iv+19+3 plates. 2.2 rupees; 4*s.* (Calcutta: Government of India Central Publication Branch.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 109: Studies in Pasture Management; a Further Report on the Seasonal Composition of certain South African Pasture Grasses in relation to their Manuring and Intensity of Grazing. By A. J. Taylor. (Division of Chemistry Series, No. 120.) Pp. 19. (Pretoria: Government Printing Office.) 3*d.*

Union of South Africa: Department of Mines and Industries: Geological Survey. Memoir No. 28: The Bushveld Igneous Complex of the Central Transvaal. By Dr. A. L. Hall. Pp. 560+41 plates. 10*s.* Memoir No. 29: The Building Stones of the Union of South Africa. By W. Wybergh. Pp. 244+11 plates. 7*s.* 6*d.* The Geology of the Country surrounding Vryheid: an Explanation of Sheet No. 102 (Vryheid). By Dr. W. A. Humphrey and Dr. L. J. Krige. Pp. 66. 5*s.*, including Map. (Pretoria: Government Printing Office.)

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 5, No. 3 (Mathematics No. 2): Über Flächen und Kurven (I), von Sôji Matsumura; Beiträge zur Geometrie der Kreise und Kugeln (1), von Sôji Matsumura. Pp. 33-142. (Taihoku.)

Bulletin of the Earthquake Research Institute, Tôkyô Imperial University. Vol. 10, Part 3, September. Pp. 499-603+plates 59-91. (Tôkyô: Iwanami Shoten.) 4.40 yen.

Seismometrical Report of the Earthquake Research Institute, Tokyo Imperial University. 1932, Part 1 (January-March). Pp. 6+2 plates. (Tokyo.)

The Rockefeller Foundation. Annual Report, 1931. Pp. x+420 (33 plates). (New York City.)

Scientific Publications of the Cleveland Museum of Natural History. Vol. 3: Physiology of the Temperature of Birds. By S. Prentiss Baldwin and S. Charles Kendeigh. Pp. x+196+6 plates. (Cleveland, Ohio.)

Annual Report for the Year 1931 of the South African Institute for Medical Research, Johannesburg. Pp. 65+2 plates. (Johannesburg.)

CATALOGUES

Cambridge Oscillographs. (List No. 118.) Pp. 32. (London: Cambridge Instrument Co., Ltd.)

Moll Recording Microphotometers. (MF.33.) Pp. 8. (Delft: P. J. Kipp and Zonen.)

Book Bargains. Pp. 24. (London: W. J. Bryce.)

SATURDAY, DECEMBER 3, 1932

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Industrial Surveys and Employment Problems*

AMONG the discussions at the recent meeting of the British Association which were given particular attention in the general Press were those arranged by the Section of Economic Science and Statistics on international migration and on the location of industries. There are, however, still many persons to whom the relation between science and problems of this type is as yet obscure. It is indeed far from being generally realised that the complex issues and intricate problems presented by international migration in the twentieth century can only be resolved by the scientific study of the numerous factors involved.

Similarly, in the national migration problems which are bound up with the unemployment problem, the bearing of scientific determination and analysis of the essential facts is only now being perceived. The social and industrial difficulties of the last two years, the magnitude of the post-War unemployment problems, have led to the active discussion of such questions as whether the present location of industries is the most economic that could be devised ; whether, under private enterprise, manufacturing industry is becoming less or more localised and whether its tendency is to render the prevention of maladjustment of labour more or less difficult.

Definite indication of the desire to ascertain the features of a rational location of industry or of the deliberate planning of social in relation to industrial resources is afforded by the invitations extended last year by the Board of Trade to various universities to conduct industrial surveys of their respective surrounding areas. It was suggested that such inquiries should cover not merely the present industrial position of the respective areas but also the prospects of early expansion and new development, having regard to recent industrial developments, and an assessment of the prospective employment capacity of the various industries in the area as a basis of estimating the probable volume of labour surplus to the requirements of individual industries within the next few years.

The mere suggestion that such an inquiry should be entrusted to the universities is significant of a changed attitude to the contribution which the

* Board of Trade. An Industrial Survey of the Lancashire Area (excluding Merseyside) made for the Board of Trade by the University of Manchester. Pp. ix + 380. (London : H.M. Stationery Office, 1932.) 6s. net.

universities have to make to the modern State. It obviously indicated an appreciation of the ability of the universities to render services which go beyond the mere training of men and women qualified to fill important positions in industry, in government, municipal or social service. The provision of men and women trained to learn quickly and accurately to grasp the essential problems of a technical problem, to analyse it and develop a plan of action, and possessing a sense of values which enables them more and more closely to relate knowledge to action or policy as their judgment matures with experience, is a function of growing importance in this scientific age, but it is only one of the ways in which the universities can serve the community. The terms of reference of these surveys suggest that the universities possess not merely the powers of conducting such social research but also the perspective and sense of values which are essential to the presentation of an authoritative and impartial analysis of the facts thus assembled.

There have now been presented to the Board of Trade no fewer than five such surveys. A survey of south-west Scotland has been completed by the University of Glasgow, while the University of Wales, Cardiff, has issued its report on the South Wales area. Surveys of the Merseyside area and of the remaining Lancashire area carried out by the Universities of Liverpool and Manchester respectively have followed that on the industrial area of the north-east coast by the University of Durham. The five surveys together not only provide a most valuable analysis of industrial conditions in the areas covered but also afford a basis for assessing the importance of such contributions of university resources to the national welfare.

In the first place, it is pertinent to observe that the presentation of such a report by a university confers upon the report an authority and an assurance of impartiality which is not easily otherwise obtained. The industrial situation has frequently suffered from *ex parte* statements which differed widely in themselves but could not be verified against some reliable and independent authority. An accurate estimate of the problem presented by surplus labour is impossible apart from some such inquiry and analysis, and accuracy and authenticity are essential if confidence is to be placed in the deductions or recommendations based thereon. Mr. A. G. H. Dent, in a paper before the Department of Industrial Co-operation at the recent British Association meeting, specially stressed the value of statistics obtained by absolutely reliable authority as a means of avoiding suspicion and misunderstandings in any industrial dispute.

The Lancashire survey brings to light the high incidence of unemployment among workers in the age group 18–24 years, and sets in its true significance for national or social economy this incidence upon workers at a period in the working lives when they should be rapidly approaching maturity of industrial skill and adaptability and when they should be most capable of moving into other industries or localities. Similarly, the analysis of the inflow and outflow of labour is characterised by a concern for social consequences that could scarcely have been found in any inquiry initiated by industry itself, and leads to definite suggestions for regulating the recruiting of labour for the cotton industry in all districts. The survey demonstrates that in the absence of any organised effort by the cotton industry or the State to control the flow of juveniles into the industry, heavy unemployment and restricted earnings of adults did not deter very large numbers from entering the industry. Nor is there any full and accurate information from year to year as to the numbers entering the industry at the age of fourteen years, or their progress during their early working years. The tracing of the industrial history of juvenile workers in this way is an obvious preliminary to the difficult task of regulating entry and avoiding blind-alley occupations, apart from the opportunity for an attempt to secure for every entrant the advantage of a reasonable period of skilled instruction in his occupation.

The analysis of the position of the cotton industry presented by the report of the University of Manchester emphasises the importance of such independent social research. Thus the immobility of labour in Lancashire is largely due to social factors—the prevalence of the family income, the preponderance of female labour, the custom of women workers continuing at work after marriage, the high concentration of unemployment in relatively isolated districts, and the reluctance of workers to recognise the existence of a permanent surplus. Such proposals as the abolition of the short-time working and under-employment of labour which result from the existence of permanent surplus capacity of capital equipment and labour would reveal the real extent of the labour surplus, but so long as the displacement and recruitment of labour is unorganised, the burden

of unemployment will not be distributed in a manner causing a minimum of loss or damage to the labour resources of the industry.

Nowhere is the advantage of such independent research greater than where it touches the effect of technical changes on the demand for labour. So far as the cotton industry is concerned, it seems clear that no appreciable part of the existing surplus of labour can be attributed to technical 'rationalisation', but there are signs that changes are impending which will radically increase the physical output per person employed and consequently displace labour, if the aggregate output remains the same. The report gives an unbiased analysis of four new methods of production which are considered to present the most serious labour difficulties and its observations cannot be ignored by either side. The 'more looms per weaver' system presents the most serious problems, bringing about a decrease in production per loom but an increase in production per weaver; while the weekly earnings of the weaver are maintained or slightly increased, the weaving labour costs fall and also total costs per unit of output. The report observes that in the negotiations between employers and trade unions, the problem of mitigating the effects of further additions to the surplus of labour in the weaving districts does not seem to have been scientifically examined and urges as an essential condition that collective bargaining should be defended against the inclination of individual firms to break away from existing wage agreements. Given collective bargaining, it is considered that there is no reason why the introduction of the system should not be planned so far as is practicable to give security of employment to the workers who are retained and to regulate displacement so that the burden falls on those best able to bear it.

The value of this survey is equally apparent in its discussion of the position of the expanding industries and of the possibilities they offer of absorbing the surplus of labour from other industries. It is, however, evident that the survey is only a start towards the handling of the unemployment problem on scientific lines: "Lancashire's difficulties," says the report, "are essentially of the type which calls for long-distance treatment and far-sighted planning, based upon the intensive research of a continuing character, and the Survey has provided the opportunity for a critical examination of the existing statistical material and has revealed many serious gaps in the information which must be made available if continuous investigation is to yield the most useful results." The report proceeds to emphasise the importance of compiling much more frequently than at present statistical material, the primary and chief value of which lies in its utility in economic research. "Increased funds devoted to the wider and more complete charting of the national economic system would be a sound investment, despite the urgent campaign for national economy."

The report punctuates its plea for such research by concrete proposals addressed alike to the national and local authorities, to trade unions and to employers' associations, for the collection of the specific statistics required. It thus envisages a definite field of social economic research which is fully in keeping with the programme advocated, for example, by Prof. W. McDougall. These surveys attest both the resources and the capacity of the universities to undertake such research and there is little doubt that it would be to the great advantage of the community if some of the effort at present directed to the advancement of the physical sciences were directed to these ends.

Apart from the corrective to that dangerous tendency in industry and politics to ignore or avoid unpleasant facts and disregard the consequences of a selfish or sectarian policy, research of this type has other advantages. It gives a striking demonstration of the capacity of the scientific worker for leadership and relates university life intimately with the main stream of national life; the recent suggestion of Mr. Alan Chorlton, M.P., for the formation of a Research Council in Manchester appears to be prompted by the survey and indicates the educational value which such research can possess. It also encourages a widespread appreciation of the value of scientific training and technique in the solution of social, economic, and industrial problems. Both factors should promote the production and acceptance of leaders and administrators whose qualifications for office include the indispensable capacity of assessing at first hand the technical factors in the problems they have to solve. Without such capacity, there is no prospect of the planning of our national material and social resources on national lines, of their being wisely co-ordinated with world resources in a spirit of international co-operation, or of that right relation of knowledge to action upon the rapid evolution of which the security of civilisation depends.

Κτῆμα ἐς ἀεί

Faraday's Diary: being the various Philosophical Notes of Experimental Investigation made by Michael Faraday, D.C.L., F.R.S., during the Years 1820–1862 and bequeathed by him to the Royal Institution of Great Britain. Now, by order of the Managers, printed and published for the first time, under the editorial supervision of Thomas Martin. With a Foreword by Sir William H. Bragg. In 7 vols. Vol. 1: Sept., 1820–June 11, 1832. Pp. xxv + 430. Vol. 2: Aug. 25, 1832–Feb. 29, 1836. Pp. xvii + 467. (London: G. Bell and Sons, Ltd., 1932.) 7 vols., £12 12*s.* 0*d.* net.

THE Faraday diary is not a find in the spectacular sense of that of the Boswell papers. Faraday's laboratory notebooks, various lecture notes and account books, the notes which he took of lectures by Tatum and by Davy, with specimens of various books bound by his own hands were gifted, as the expressive Scots word has it, to the Royal Institution by himself or by his widow. No mystery surrounds these possessions; no ebony cabinet has been rifled to reveal manuscripts long lost and long sought, as those destined to make the name of Boswell a by-word in the mouths of the examiners of would-be doctors of philosophy. These treasures have been jealously preserved in the archives of the Royal Institution; privileged observers have been permitted to see and to handle them.

Nonetheless, it is a red letter day which has seen the publication, even in a strictly limited edition, of the laboratory notebooks. These, ranging as they do over the most fruitful years of Faraday's life, afford a picture of the development of the mind of a great genius, of his gropings in the dark, and of those flashes of insight which have led to a solution of some of the fundamental problems of physical science—a picture which will be, in the phrase of Thucydides, 'a possession for all time'.

The publication of these notes is all the more valuable, inasmuch as the extant biographies leave something to be desired. The biographical traditions of the Victorian, and the paulo-pre-Victorian era were, despite the examples set by Lockhart and by Trevelyan, arid and unliving. The two- and three-deckers of the period, equally with the series of smaller volumes in which great reputations were decently buried (how Mark Pattison's "Milton" even now stands out from the ruck!), all serve to show that the contemporary tradition was at one with the tradition of portraiture—what has been described as a head sticking out of a suit of clothes.

Faraday has not escaped. The full-dress biography by Bence Jones is, despite its value as a storehouse of facts, a trifle heavy; Tyndall's affectionate little volume tends to slip, as was Tyndall's wont, from sentiment into sentimentality; Silvanus Thompson's study, by far the best account of Faraday's scientific work, still bears some of the stigmata of the age. The most lively contemporary account of Faraday's vivid and eager personality is to be found in the pages of a lesser-known sketch—that written in 1870 by J. H. Gladstone.

Every document, then, that will help to provide a complete portrait of the man in his habit as he lived, is of importance, for Faraday's is an intriguing personality, not alone in the genius that it shows, in its transparent honesty, gentleness and almost excessive humility, but also in its baffling simplicity. Cheerfulness, eagerness, playfulness are prominent—a contemporary draws a pleasant picture of a British Association dinner at Ipswich in 1851, at which Faraday amused himself by cutting boomerangs of card and projecting them across the table at his friends—but over all and dominating all is a single-hearted devotion to the advancement of science which can rarely have been surpassed in the long history of the development of scientific thought.

This devotion had strange consequences, among them a complete indifference to political events of the first magnitude. Is there any other instance on record, in the development of an active-minded young man of four and twenty, of such an entry as occurs in Faraday's journal for March 1815—three months before Waterloo? "I heard for news that Bonaparte was again at liberty. Being no politician, I did not trouble myself much about it, though I suppose it will have a strong influence on the affairs of Europe."

Nor, great as was his private benevolence, does Faraday seem to have taken any pronounced interest in schemes for social betterment. He lived for his science and his religion, and neither material rewards, nor the highest offices, had the slightest attraction for him. To his friend, pressing him to accept the presidency of the Royal Society, "Tyndall," he said, "I must remain plain Michael Faraday to the last; and let me tell you now, that if I accepted the honour which the Royal

Society desires to confer upon me, I would not answer for the integrity of my intellect for a single year."

The volumes before us testify eloquently to this devotion. They cover the period 1820–1836, and so include some of the most fundamental of Faraday's discoveries. The story of the isolation of benzene, and the examination of its properties, the liquefaction of gases, and the results of that concentrated ten days' work, the centenary of which was celebrated last year, may be read now as they were first set down by Faraday in the heat of the chase.

We do not here, however, attempt any detailed analysis of the two volumes now published. That may more fittingly be done at a later stage, when an opportunity will be afforded to pass in review the contents of the seven stately volumes which are to form the complete diary. Meanwhile we may say with assurance that the publication of the first two volumes has amply justified the policy of the managers of the Royal Institution. The diary is much more than a record of laboratory experiments and figures; it provides the material for an analysis of the development of Faraday's thoughts concerning the problem in hand. Its value, as we have before emphasised, lies in the opportunity which it gives, to a future historian of physical science, to limn a picture of the genius of Faraday and, indeed, of some of his personal qualities which would be quite impossible to anyone who was not fortunate enough to have access to the diary. The entries are, on the whole, restrained enough; here and there one may find italicised a '*very good*'; yet the general impression left after a perusal of the pages of these volumes confirms the pen picture of the "young-looking man of about thirty years of age . . . his cheerfulness of disposition often breaking out in a short crispy laugh, but thoughtful enough when something important is to be done". We can visualise, too, the experimenter of mature years who, ready for the day's work, would "descend into the laboratory, give a quick glance round to see that all was right, take his apron from the drawer, and rub his hands together as he looked at the preparations made for his work. There must be no tool on the table but such as he required. As he began, his face would be exceedingly grave, and during the progress of an experiment all must be perfectly quiet; but if it was proceeding according to his wish, he would commence to hum a tune, and sometimes to rock himself side-ways, balancing alternately on either foot. . . . He would put away each tool in its own place as soon as done with . . . and he would not unnecessarily take a thing away from its place. . . . No bottle was allowed to remain without its stopper; no open glass might stand for a night without a paper cover; no rubbish was to be left on the floor."

More than anything else, the cumulative effect of the day by day entries in the diary is to throw into relief Faraday's intense desire to see and do everything for himself. No experimental fact was to be taken on trust; as he himself writes to Becker: "I am never able to make a fact my own without seeing it. If Grove, or Wheatstone, or Gassiot or any other told me a new fact, and wanted my opinion either of its value, or the cause, or the evidence it could give on any subject, I never could say anything until I had seen the fact. For the same reason I never could work . . . by students and pupils. All my work had to be my own." The same characteristic appears in a pleasant record by Mallet of a visit which he paid to Faraday in order to show him how slips of Muntz's yellow metal, ordinarily flexible and tough, became at once rigid and brittle when dipped into a solution of pernitrate of mercury. The demonstration was made, Faraday standing nearby. He made no comment whatever, but picked up a piece of the metal, bent it, dipped it into the solution and broke it into small pieces. Then, "Yes," said he, "it *is* pliable, and it *does* become instantaneously brittle."

So when Tyndall showed him the then novel phenomenon of calorescence he "looked on attentively, putting on his spectacles to observe more carefully, then ascertained the condition of the experiment and repeated it for himself; and now, quite satisfied, he turned with emotion to Dr. Tyndall, and almost hugged him with pleasure."

The complete diary will form a commentary of inestimable value on one of the most romantic lives in the history of science. Looking into its volumes in retrospective mood, we may see something of the mettle of the bright-eyed newspaper lad, the bookbinder's apprentice, the young laboratory assistant, widening his knowledge, and testing his strength at the meetings of the City Philosophical Society; the pages of the earlier volumes will show him in the fulness of his powers, enriching chemical and physical science by discovery after discovery of the first magnitude, yet still retaining that boyishness of disposition

which sent him with his attendant "to Astley's, to see the horses" to celebrate the occasion when he had first made "the wires go round the magnet". It may be that the last volume will show something of that pathetic and yet not wholly painful decline to which he himself alludes in the Friday evening discourse on platinum which he delivered in February 1861, six years before his death, a decline which left him broken in mind and frail in body, yet still preserving his gentleness of spirit and thought for others, still able to find beauty in the rolling of a thunderstorm and the hues of a sunset.

But the story should not end here; there are, surely, records still unpublished to which Mr. Martin may apply his energy and his scholarship. More than all, there still remains to be written an authoritative exposition of the origin and growth of the Royal Institution. Those who know something of the contributions made by London to the advancement of science know, too, that in the vastness of London, individual contributions of the first importance are apt to be lost. Of these contributions none is more weighty than that made by the Royal Institution. The part which it has played in fostering research and in popularising knowledge is well known. From its earliest days, when it was associated with the dramatic discoveries of Davy, it has been fortunate; all Faraday's labours are indissolubly connected with its laboratories, and the work of succeeding directors has added to the lustre of these early discoveries. Even to-day, Faraday's personality dominates its work. To his genius for exposition we owe the inception of the Christmas lectures, and an institution which is probably unique in the scientific world—the Friday evening discourses. Is it too much to hope that the recrudescence of interest in Faraday's life and work which is evidenced by the publication of the diary may extend to the walls of the Institution wherein he laboured so long, and for which he had so deep and so lasting an affection? The story is no jejune one—it is picturesque enough in its details, and touches the development of more than a century's physical science at many points of fundamental interest. Incidentally, it will afford an opportunity to do justice to the memory of a natural philosopher, the story of whose life has been strangely neglected—Faraday's intimate friend and successor, John Tyndall.

It would be ungrateful to close this notice without comment on the skill and discretion which the editor has shown in the by no means easy task which he has faced. It is not difficult to see that, in turning into print some four thousand pages of manuscript written *currente calamo* and illustrated by rapidly drawn pen sketches, various delicate questions will arise concerning the reproduction of the actual punctuation, wording, spelling, and contractions. Mr. Martin has solved these problems with a degree of success that testifies alike to his scholarship and acumen. He has left the text largely to speak for itself, and confined his notes to the minimum necessary for elucidation. In congratulating him on the completion of the first portion of his task, we can offer him no better wish than that the rest of his work may attain the high standard of that already published.

ALLAN FERGUSON.

Botanical and Horticultural Biographies

Curtis's Botanical Magazine Dedications 1827–1927: Portraits and Biographical Notes. Compiled by Ernest Nelmes and William Cuthbertson. Published for the Royal Horticultural Society, London. Pp. xxi + 400 (100 plates). (London: Bernard Quaritch, Ltd., 1931.) 30*s*.

THE intimate relationships subsisting between botany and horticulture are nowhere more clearly seen than in the history of *Curtis's Botanical Magazine*. Founded in 1787 by William Curtis, the author of the "Flora Londinensis", the *Botanical Magazine* now includes more than nine thousand hand-coloured plates, with descriptive letterpress, of plants grown in gardens, public or private, and at the present day under the able editorship of Dr. O. Stapf it enjoys a higher botanical reputation than ever before.

The volume under review contains portraits and short biographies of the founder and of the hundred eminent botanists and horticulturists to whom the volumes of the *Botanical Magazine* have been dedicated during the century 1827–1927. Its publication has been made possible by the generosity of Mr. William Cuthbertson, chairman of Messrs. Dobbie and Co., of Edinburgh. The copying of the portraits has been carried out by Mr. G. Atkinson, artist at the Royal Botanic Gardens, Kew. More than half are reproduced from photographs, engravings and drawings in the Kew collection, the remainder having been obtained from various sources. Only one is wanting, that of Mrs. Wray,

of Oakfield, Cheltenham, to whom vol. 67 was dedicated in 1841. A special request is made that any reader who may know of a portrait of this lady should send particulars to the secretary of the Royal Horticultural Society. Owing to the varied nature of the originals, the standard of the portraits is very unequal, some being exceedingly good, while others, such as that of H. J. Elwes, are unsatisfactory.

The biographical notes are with few exceptions written by Mr. E. Nelmes, assistant botanist at Kew, who was also responsible for assembling the portraits. They are of a general length of 1½–2 pages, and summarise very clearly the principal events in the lives of the persons concerned. Much of the information supplied is not readily accessible elsewhere, and the work will be indispensable to all interested in botanical and horticultural biography. The general absence of critical estimates of the character and scientific work of botanists of the present and past generation is to be regretted, since it makes some of the accounts appear rather colourless to those who know the men concerned. For this, however, the plan of the work and the limitations of space appear to have been mainly responsible. Apart from this minor defect, the biographical sketches are excellent.

Among the botanists commemorated are three keepers of the Kew Herbarium, D. Oliver, J. G. Baker and W. B. Hemsley, and three directors of the Gardens, J. D. Hooker, W. T. Thiselton-Dyer and D. Prain, while the Royal Botanic Garden, Edinburgh, is represented by J. H. Balfour and I. B. Balfour. More on the horticultural side are G. Nicholson and W. Watson (Kew), R. I. Lynch (Cambridge) and F. W. Moore (Trinity College, Dublin, and Glasnevin). Among those distinguished in both botany and horticulture are J. T. Mackay, David Moore and M. T. Masters. Investigators of the various floras of the British Empire include, besides the above-mentioned botanists, Wight, T. Thomson, G. King and C. B. Clarke (India), Thwaites and Trimen (Ceylon), Ridley (Malay Peninsula), F. von Mueller (Australia), Bolus and Medley Wood (South Africa).

The botanical collectors comprise Welwitsch and Gustav Mann (West Africa), Kirk (East Africa), and Augustine Henry, E. H. Wilson and G. Forrest (China). Henry made a name for himself in a different field by the "Trees of Great Britain and Ireland", written in collaboration with Elwes, who is also included in the volume, and Wilson published numerous works on botany and horticulture including the "Lilies of Eastern Asia", "The Cherries of Japan", and "A Monograph of Azaleas", the last-mentioned written in conjunction with Rehder. Vol. 95 (1869) was dedicated to Walter Fitch, the unrivalled botanical artist, whose published drawings are estimated at ten thousand.

The United States is represented by Torrey, Asa Gray and Sargent, who contributed so much to our knowledge of the North American flora, Germany by Salm-Dyck and H. G. Reichenbach, and Russia by F. E. L. Fischer and E. Regel.

Among the amateur botanists included are James Bateman, the author of the "Orchidaceæ of Mexico and Guatemala", Dean Herbert, a great authority on bulbous plants, M. J. Berkeley, the cryptogamic botanist, George Maw, who published a monograph of the genus *Crocus*, and John Ball, who is perhaps best known by his Alpine guide. The following may be singled out among the many prominent horticulturists whose portraits and biographies are given: W. T. Aiton, Joseph Sabine, Max Leichtlin, H. L. de Vilmorin, and W. Wilks, whose name will always be associated with the Shirley poppy.

The volume reflects great credit on all concerned in its production.

T. A. S.

The Moa in New Zealand

The Mystery of the Moa: New Zealand's Avian Giant. By T. Lindsay Buick. (Published under the Auspices of the Board of Maori Ethnological Research.) Pp. xvi + 357 + 27 plates. (New Plymouth, N.Z.: Thomas Avery and Sons, Ltd.; London: Francis Edwards, Ltd., 1931.) 15*s*.

PERHAPS no event in the ornithological world was more astounding than the discovery of the bones of the largest known bird, the moa, which existed in New Zealand, the fringe of the great sunken southern continent. The first mention of this bird in literature was made in Polack's "New Zealand", 1838, but no notice was taken of this by scientific men. Later on, Harris obtained a portion of a bone and gave it to Dr. John Rule of Australia, who eventually brought it to England. Prof. Owen examined it but was sceptical about its being the bone of a bird, but on further examination he was convinced that it

was indeed part of the skeleton of a large extinct flightless bird. This pronouncement was read before the Zoological Society of London on Nov. 12, 1839, and was published in the Society's *Transactions*. This bone became the type of the genus *Dinornis* which Owen introduced on Nov. 28, 1843, in the same publication, vol. 3, p. 235.

Soon afterwards the scientific world hungered for more examples and so New Zealand was exploited and thousands upon thousands of bones were brought to light, so that to-day no museum of any size is without some part of a skeleton of one of the many species of moa. From maps on pp. 163–164 of Mr. Lindsay's book showing the places where finds are recorded we gather how plentiful these birds were.

Mr. Lindsay gives the history of the Moa from the fossils of the Pliocene or post-Pliocene times when they were plentiful, up to their extinction in the seventeenth or even as some think into the eighteenth century. Many different lots of feathers are extant showing their formation and colour.

The author accepts the theory of Mr. Percy R. Lowe that these birds are descended from birds which never flew. They varied in size from fourteen feet or more in height to little fellows of about four feet, and appear to have been more common in the South than in the North Island.

It is surprising how much we are told of the life history of these birds; we know what colour they were; that in June and July they were fattest; the nest of one species is described as are the eggs of several forms; they lived on a vegetarian diet and thousands of their 'crop stones' have been found. Some skeletons were found in caves and numbers were found together in swamps, as many as eight hundred skeletons in one place. Many theories as to how these large heaps of bones were amassed are put forward, only to be rejected. Why did this bird become extinct? Was it change of climate? Was it due to man? Or had they served their turn and passed on?

Many different classifications have been advanced but the author accepts that of Oliver in "New Zealand Birds"; that is two families, five genera and twenty-two species. A bibliography and index complete the work.

This book will appeal not only to ornithologists, but also to a much wider circle of readers; in fact to all who are interested in the story of past ages, and whom it may amuse to speculate on the mystery of vanished races.

Short Reviews

The Quantity and Sources of our Petroleum Supplies: a Review and a Criticism. By Prof. J. M. Macfarlane. Pp. xiv + 250. (Philadelphia: Noel Printing Co., Inc., 1931.) n.p.

READERS versed in the literature of petroleum will recognise in this book the author of "Fishes the Source of Petroleum", published some nine years ago, who now reappears with an extensive thesis of oil origin in which metanemerteans, invertebrate fresh-water animals of widely dispersed occurrence, and apparently related conodonts, are invoked as fundamentally contributive mother substance. The argument is that life originated and thrived in fresh-water areas, spreading both landward and seaward; of this life, the most abundant group was the metanemerteans, the representatives of which are now found in fresh and salt water and moist land-surfaces. Certain strata yield conodont teeth, closely resembling pharyngeal teeth of the metanemerteans, in association with prolific oil pools. By focusing attention on environments, as illustrated by three oil-bearing formations chosen in North America, it is shown that seismic and volcanic phenomena intervened in the evolution thereof.

Great stress is laid on the consequential dust product and on its chemical and petrological composition. Such dust, falling into fresh or salt water, changed into a soft colloidal condition or hydrogel, upset the balance of quiescent aquatic life and resulted in wholesale instantaneous destruction of the most sensitive (sic) of all animals, fish. Thus their bodies were enveloped along with diatoms, algæ, etc., in a shroud of rock-dust; pressure promoted chemical reactions between the alumino-silicic substances and hydrocarbons giving rise to "an alumino-silicate of oil and protein", or definite mineral compound, the "kerogen" of Crum Brown and Scottish oil shale fame. Regard this kerogen as a complex semi-colloid or colloid subject only to change with rise of temperature; divert such changes into separate channels according to the geochemical conditions obtaining at particular epochs, and thus are oil shales on one hand, petroleum on the other, given existence. This is an ingenious philosophy, combining all the weaknesses of the organic and inorganic theories of oil origin, with few of the merits of either, and, moreover, an excellent example of the danger of generalising on two or three particular occurrences. This is a book to look into, but difficult to take seriously.

The Journal of the Institute of Metals. Vol. 48. Edited by G. Shaw Scott. Pp. xi + 350 + 33 plates. (London: Institute of Metals, 1932.) 31*s.* 6*d.* net.

IN the May lecture to the Institute of Metals, Dr. Körber, of Düsseldorf, describes his investigations into the plastic deformation of metals. These are

well known to many from the original German publications, but the convenient and well illustrated summary here given will be of much value to metallurgists, being rich in suggestions bearing on the general problem of deformation. As has frequently been the case in recent years, the light alloys form the subject of a number of communications, perhaps the most striking of which is the description of the protection of magnesium and some of its alloys by the deposition of a film of selenium. The film is self-healing to a certain extent, and serves as a basis for paint or enamels, which it causes to adhere firmly. The 'fogging' of nickel is shown to be due to the action of sulphur compounds in the presence of moisture, a basic sulphate being the final product. It is largely inhibited by a preliminary formation of a thin film of sulphide.

A general discussion on the testing of castings brings out fundamental divergencies of view, some authorities holding that tests should be made on test pieces cast separately, whilst others hold that the test pieces should be cut from the actual casting. As the only conclusive test would involve the destruction of the casting, and even the best of castings will vary greatly in properties from one part to another, it would seem reasonable that the former plan should be adopted, and this view is held widely in Great Britain. The volume contains nearly twenty distinct communications.

The Subject Index to Periodicals, 1930. Issued by the Library Association. Pp. ix + 298. (London : The Library Association, 1932.) 70s.

THIS volume has been compiled under the direction of Mr. T. Rowland Powel and contains about 28,000 references. The headings are arranged in alphabetical order by subjects and are mainly chosen from the alphabetical subject headings of the Catalogue of the Library of Congress of the United States. Under each heading the articles are arranged alphabetically by the authors' names.

The range of subjects extends far beyond science even when taken in the widest sense, but fiction and verse are excluded. To restrict the size of the "Index", periodicals already indexed by certain well-known publications such as *Engineering Abstracts, Index Medicus, Journal of the Society of Dyers and Colourists, Revue de Géologie, Royal Meteorological Society's Bibliography, Science Abstracts* and *Textile Institute Journal* are not dealt with. Yet when these exceptions have been made, there remain no less than 545 English and American periodicals that have been indexed for this catalogue. In addition to these, 24 French, Belgian and Swiss, 20 German and Dutch, and two Italian periodicals have been dealt with.

In spite of attempts that have been made to induce authors to send their papers only to well recognised periodicals, it is still true that important work may be found hidden in publications the very names of which are unknown to most men of science. It is the function of the "Subject Index to Periodicals" to reveal such hidden papers. Such work should be done by international co-operation, but until this is possible, the Library Association should receive every encouragement to continue this series of annual indexes.

Johann Kepler 1571–1630 : a Tercentenary Commemoration of his Life and Work. Pp. xii + 133 + 2 plates. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1931.) 13s. 6d. net.

THIS little book consists of three addresses given before the History of Science Society in joint session with the American Association for the Advancement of Science, together with a brief introduction by Sir Arthur Eddington and a bibliography of all the important works of Kepler. In "Kepler as an Astronomer", Dr. W. C. Rufus gives a clear and concise account of his subject which adds point to Eddington's picture of Kepler as the forerunner of the modern theoretical physicist. This address also contains general biographical particulars, in addition to a description of his work as an astronomer.

Kepler's mathematical achievements are perhaps not so well known, although they are of great importance—particularly in the infinitesimal calculus, the simplification of computations and the use of logarithms. These and other contributions to mathematics are described by Dr. D. J. Struik; while Kepler's philosophical and mystical outlook, which was so intimately related to his other work all through his life, is dealt with by Dr. E. H. Johnson.

In spite of some inevitable overlapping of subject matter, and the limitations imposed by its size and origin, the book is a useful contribution to the history of astronomy. The bibliography, in particular, compiled and annotated by F. E. Brasch, chief of the Smithsonian Division of the Library of Congress, should be most valuable.

Flowerless Plants. By Dr. Dukinfield Henry Scott. (Part 2 of An Introduction to Structural Botany.) Tenth edition, re-edited by F. T. Brooks. Pp. xvi + 332. (London: A. and C. Black, Ltd., 1932.) 7s. 6d. net.

THIS well-known book on the cryptogamic plants needs no introduction and the fact that it is now in its tenth edition speaks well for its success. This edition has been re-edited by Mr. F. T. Brooks, with the result that the new types *Peronospora, Saccharomyces* and *Euglena*, have been added. All three additions are important, representing a plant disease, a simple fungus of great economic importance, and a flagellate. *Cladothrix* has been omitted. The results of recent researches in Algæ and Fungi have been incorporated so far as is possible into the text. Written by Dr. Scott, and now revised with the advice and help of well-known specialists, the new edition of this book will continue to be an authoritative introduction to the subject.

Wood Anatomy as a Link between Botany and Forestry*

By B. J. RENDLE

THE conception of forestry as being ultimately dependent for its advance upon the interaction of a number of more or less independent basic sciences is a familiar one. The problems associated with the tree considered as a plant and with the forest considered either as an ecological unit or an artificial crop call for special methods of attack which, while primarily concerned with some aspect of forestry, can incidentally contribute to the general fund of botanical knowledge. The study of wood anatomy, with special reference to the production and utilisation of timber, is a case in point. In modern times this somewhat specialised subject has advanced along several different lines according to the points of view of the investigators concerned. The demand for practical methods of identifying and investigating the physical properties of commercial timbers has stimulated the study of species in this category. This has naturally been carried out more with reference to the important timbers of certain geographical regions than with botanical groups, and the woods of the north temperate zone in particular have received more than their fair share of attention.

In Germany, long before the end of the last century, certain of the timber-producing species of outstanding importance to Continental forestry practice were submitted to intensive studies of their anatomical-technical characters, which, besides yielding results of direct practical application, were of value in instigating further research in the peculiar problems of plant physiology which are associated with the great size and long life of trees. More recently, the opening up of botanical exploration in the tropics has offered a wide field of investigation in wood anatomy. Numbers of new genera and species of great potential value as a source of timber incidentally provide material for the study of systematic anatomy which for richness and variety is far superior to the limited and rather specialised arborescent flora of the north temperate regions.

Botanical exploration in an entirely different direction, geological rather than geographical, has also been the means of advancing our knowledge of the structure of wood, particularly as regards the gymnosperms. Study of the structure of fossil plants has been of the greatest importance in the development of the subject; it has even been observed that at one time woody plants were better known anatomically in a fossil than in a living condition, and it is safe to say that some of the most valuable studies of coniferous woods have been prompted by a desire to elucidate the relationship of their fossil allies and their connexion with recent forms. These researches have resulted in the formulation of criteria capable of wide application, and in this way palæobotany has probably had a stronger influence than either taxonomy or physiology on the progress of wood anatomy.

In considering the systematic value of wood characters, as with any other part of a plant, the first essential is to recognise the kinds of characters that are to be found. Different writers have divided characters into various classes and sub-classes, each with a more or less descriptive name, but for the present it is only necessary to refer to the two main divisions, namely, those which can be regarded as adaptations to environment, that is, 'biological characters', and those which have no apparent relation to the environment and remain unaffected by variations in the conditions of growth; for these the term 'inherent characters' seems to be the most appropriate.

It is abundantly clear that the anatomical structure of wood is a product of two factors, heredity and adaptation, and the successful employment of anatomical characters for systematic purposes depends on our being able to distinguish constant, inherited characters from those which are due to the influence of environment. In the course of generations of research, botanists have arrived at a fair idea of what morphological characters are constant, and to what extent they can be interpreted as indicating relationships. But in the case of wood there is relatively little information on this point and the need for further work of this kind is most pressing. The reason for this is not far to seek. The plants which are the subject of investigation in most fields of applied biology are generally available in a more or less complete condition, or at the least, their naming and classification is based on a study of those parts which are easily obtainable, but in the case of trees the difficulty is that the plant is such a large object; it is a laborious undertaking to examine the complete range of morphological and anatomical variation in a single tree, and when it becomes necessary to take into account the further variations induced by different conditions of growth, the problem assumes a much more formidable aspect.

Systematic botanists who have had to concern themselves with the critical study of trees from herbarium specimens are familiar with the morphological variation which occurs and which has often led to two or more specific epithets being attached to the same species when the trees have been described and named on incomplete botanical material. The similar variation in the structure of wood has not been sufficiently realised by all anatomists and this has in turn resulted in descriptions and keys, based on a study of inadequate material and on characters

* From a paper read before a joint meeting of Sections K (Botany) and K* (Forestry) of the British Association, at York, on Sept. 5.

which are not specific at all but only due to different conditions of growth, being used to differentiate between species. Many of the early researches in wood structure were directed towards the study of the size of the wood elements and their distribution within the growth ring, chiefly for purposes of identification. It is not yet fully realised in certain quarters that these features vary from tree to tree and that they vary more widely in different parts of the same tree.

Now, although this variation is considerable, the position of affairs is not so hopeless as it might appear at first sight. It will not be necessary to cut and examine microscopically the structure of hundreds of sections from dozens of different trees in order to obtain a reasonably accurate picture of the typical wood structure of every species. But it is necessary to examine in detail a few species exemplifying selected types of structure in order to ascertain the limits of variability of each diagnostic feature and to discover if possible the laws governing such variation. Critical anatomical surveys of this kind can only be undertaken by institutions in a position to obtain carefully selected trees and to examine them according to an ordered system of routine.

At the Forest Products Research Laboratory at Princes Risborough, the main consideration which underlies investigations in wood structure is naturally the influence of structure on the technical properties of the timber. There is no need to labour the point that in technological research one of the first essentials is to discover as much as possible about the physical nature of the material concerned. The cellular structure of wood is one of the most important factors in determining its physical properties, and a close correlation exists between changes in structure and changes in technical properties. The variation in the properties of timber grown under different conditions of climate, soil and sylviculture is one of the big disadvantages of the use of wood in industry for purposes which are in any degree exacting. The problem before us is to investigate the structure of a sufficient quantity of each species, grown under different conditions and in different parts of the country, so as to obtain an idea of the normal range of variation that is likely to occur. The same timber that is examined anatomically in the Laboratory is also subjected to technical tests. In this way its general quality is correlated with the growth features, thus indicating to the forester the conditions of growth necessary to produce first quality timber. At the same time, the results of these investigations are the means of increasing our knowledge of the general principles underlying the relation between the structure and the properties of wood, knowledge which is in demand for assessing the technical value of wood from an examination of its structure and for the proper understanding of the peculiar behaviour of wood under varying conditions of temperature, humidity and so on.

The lines of research that have been briefly outlined above, although directed primarily towards the solution of economic problems, are incidentally of importance in increasing our knowledge of the systematic anatomy of wood, and by virtue of their somewhat intensive character they are of special value in enabling us to distinguish between inherent and biological characters. From the severely practical point of view, this is of obvious importance in order to place the identification of timber specimens on a sound scientific basis, and there is ample evidence that the anatomical characteristics of wood can usefully be taken into account in the solution of taxonomic problems. There can be no serious suggestion of attempting a natural classification of woody plants on the sole basis of their vascular anatomy, but on the other hand there is no gainsaying the fact that the nearest approach to the ideal system of classification will be based on a complete knowledge of the external morphology and internal anatomy of plants. Wood anatomy is essentially auxiliary to taxonomy but it is an auxiliary that botanists cannot afford to neglect; it is, for example, of special value in throwing light on the systematic position of anomalous genera and provides a valuable test of the homogeneity of a family.

From the very nature of the subject the study of wood anatomy is confined to a comparatively small number of specialists, most of whom have been led thither by way of forestry or forest products research. In the belief that mutual benefit would result from some measure of organised co-operation between workers in different parts of the world, the opportunity offered by the Fifth International Botanical Congress at Cambridge in 1930 was taken by a few interested parties to discuss ways and means of effecting such co-operation. Eventually an International Association of Wood Anatomists was formed, which has as its object the advancement of the knowledge of wood anatomy in all its aspects; this Association seeks to achieve its object by enabling workers in the same field to get in touch with each other, by facilitating the exchange of ideas, information and material and by working towards standardisation in terminology and methods of description.

Co-operative work has already been started on the preparation of a polyglot glossary of terms used in describing woods. Anyone who has had occasion to study the recent literature of the subject in different languages will have noticed the lack of uniformity in the use of terms and the need for some measure of standardisation. As a first step in this direction a provisional glossary of terms has been compiled in six languages, and by circulating this repeatedly to experts in different countries for corrections and suggestions it is hoped in course of time to achieve an approach to finality.

What is perhaps a still more important undertaking is the effort to increase the amount of

authentic material available for research. This can only be done by inducing collectors to obtain wood samples from the trunks of the same trees from which herbarium material is taken. It should be our aim to build up wood collections comparable to our national herbaria; those that we have are hopelessly encumbered by commercial samples of timbers and specimens collected in all good faith but entirely without regard to the need of ensuring their true botanical authenticity. There can be no better example of the need for co-operative effort than the preliminary work necessary to establish on a sound basis the thorough investigation and successful utilisation of the timber resources of the overseas dominions of the British Empire.

Stellar Radial Velocities

By Dr. R. O. Redman

THERE has recently been published by the Lick Observatory a General Catalogue of the Radial Velocities of Stars, Nebulæ, and Clusters by Joseph Haines Moore.* This gives all radial velocities published up to January 1, 1932, and includes 6739 stars, 133 gaseous nebulæ, 18 globular clusters and 90 extra-galactic nebulæ. For some time a need has been felt for such a compilation, and after consultation with the members of the radial velocity commission of the International Astronomical Union, which includes practically all the workers active in this field, Dr. Moore undertook the task. Himself a radial velocity observer of considerable experience, he has carried out this work very thoroughly and the publication forms a compact collection of observational data of extremely great value.

It is very fitting that this catalogue should be issued by the Lick Observatory, which has played such a leading part during the past forty years in the measurement of radial velocities of stars and nebulæ. The first attack on the measurement of the Doppler shift in stellar spectra was made by Huggins in 1866, using visual methods, but the task proved difficult, and reasonably reliable results were not obtained until Keeler's work with the Lick 36-inch refractor about 1890. Even then velocities were obtained only with one or two of the brightest stars in the sky.

However, at about this same time, line of sight velocities were successfully measured at Potsdam by photography. The great superiority of the photographic method was quickly realised and soon extensive work was started, particularly by Campbell and his associates at the Lick Observatory. Observations have been accumulating with increasing rapidity ever since. As is well known, the results have been among the most valuable of astrophysical data and have found many applications, in the determination of masses in binary stars, in the study of variable stars, in stellar motions and the dynamics of the Milky Way system. Radial velocity technique has also contributed support to relativity theory in observations of Sirius B and to the theory of the expanding universe in recent observations of the spiral nebulæ.

The practical problem of radial velocity determination consists in the measurement of displacements of lines in an absorption spectrum formed by light from an extremely faint source. The unavoidable complications present in all astronomical observations, namely a rotating earth and an unsteady atmosphere of varying transparency, have also to be contended with. The average stellar velocity in the line of sight is around 15 or 20 km./sec., which corresponds in the ordinary photographic region of the spectrum to a Doppler shift of approximately one quarter of an angstrom.

The experience of the past thirty or forty years has indicated with little ambiguity the most desirable type of instrument to use. A telescope of large aperture is essential—36 in. is the least size with which any important amount of work is done at present—and, although refractors have in several cases given excellent service, it is generally considered that reflectors are more desirable. Their advantages lie in ease of construction, in their perfect achromatism, in their greater efficiency in the region of shorter wavelengths and in the long equivalent focal length which may be obtained without an inconveniently long telescope tube. The Cassegrain arrangement of mirrors, with a convex secondary reflecting the beam back through a hole in the centre of the primary, is undoubtedly the best.

The spectrograph is normally carried on the telescope, and since it may then be required to work in almost any position, it has to be constructed and mounted with special precautions against flexure or distortion of any kind. Prisms are usually employed since they are less wasteful of light than are diffraction gratings. One prism is most commonly used, although the number may be two or three for the brighter stars, and several interchangeable cameras of various focal lengths are usually available. In this way a fairly wide range of dispersions can be provided, varying perhaps from near 10 to around 100 angstroms per millimetre at Hγ (λ 4340) and suitable for use with stars of a wide range of apparent brightness. Since effectively the observing is done in the open air, the spectrograph should be enclosed in an insulating case and its temperature controlled by a thermostat. Exposure times vary enormously with magnitude and type of stars, with observing conditions and with the particular instrument used. Extensive radial velocity work is rarely carried out where more than one or two hours per photograph are required in fair weather. The

* Publications of the Lick Observatory, Volume 18, 1932.

resulting photographs are measured on special micrometer machines, the positions of the spectral lines being determined with reference to a comparison spectrum of the iron arc or some other convenient standard source.

Particular reference may be made to the work on extra-galactic nebulæ, the spectra of which almost without exception show displacements corresponding to large velocities of recession. The objects in question are generally extremely faint, and in addition their light is spread over an appreciable area of the sky, instead of being concentrated like that of a star. They are more difficult to observe than the diffuse and planetary nebulæ, since they have absorption, not emission, spectra. Pioneer work was done by V. M. Slipher at the Lowell Observatory, Flagstaff, but the more extensive recent measurements have been made at Mt. Wilson, where spectra of extremely small dispersion are taken with a special short focus camera lens working at f 0·6. The slit is used very wide and the exposures are sometimes very long, extending over several nights. In the photographs it is generally possible to distinguish only one or two of the strongest features of the spectrum, but the displacements, thanks to their great size, are usually determined well within ten per cent.

Reverting to more normal stellar work, the errors of measurement of radial velocities, as one might expect, vary a great deal according to the dispersion of the spectra and the nature of the spectrum lines. With a one prism instrument giving 25 or 30 A./mm. at Hγ, the probable error per plate is approximately 1 km./sec. in the case of a star with many sharp spectral lines, but with some spectra where the lines are few and nebulous, this error may easily exceed 5 km./sec. Systematic errors have in the past usually been evaluated by intercomparison of results from different observatories. Their average value is generally rather less than 1 km./sec. Now, however, as work is being pushed further to fainter apparent magnitudes, there is considerably less overlap than formerly between the work at one observatory and another, and standard stars are coming into use for the purpose of checking systematic errors. A list of such stars was published some years ago by the radial velocity commission of the International Astronomical Union and has proved very valuable. It is at present being revised and extended to fainter stars.

An inspection of Dr. Moore's catalogue gives some idea of the total progress made to date in this work. Thanks chiefly to the Lick Observatory, all stars have been adequately observed down to magnitude 5·51, but apart from this no group of stars has been completely observed over both northern and southern hemispheres. In the northern sky various groups of objects such as the Boss stars, the brighter dwarfs, the O to B5 stars down to magnitude 7·5, and certain classes of variables, have been observed, and further systematic work is being pushed forward, particularly at the Lick, Victoria and Mt. Wilson observatories. On the other hand, the southern sky below declination $-25°$, with the exception of the brighter stars just mentioned, remains practically untouched. Neglecting for the moment the fact that there are known to be many variable and peculiar stars of great interest in this region, knowledge of which would be very greatly advanced by radial velocity observations, this gap in our data is most serious in work on stellar motions. Until it is filled, observational studies of such questions as galactic rotation and certain other features of stellar movements must necessarily be incomplete.

Unfortunately, there seems to be no immediate certainty of a suitable telescope being established in the southern hemisphere for this purpose. At the recent meetings at Cambridge, Massachusetts, the radial velocity commission and later the general assembly of the International Astronomical Union, fully alive to the unsatisfactory nature of the present situation, passed a resolution asking that every effort be made to further any project aiming at the establishment and efficient working in the southern hemisphere of a large reflecting telescope for stellar spectroscopy and in particular for the determination of radial velocities. It seems unfortunate that some of the large sums of money devoted to several schemes at present on foot to build large instruments in the northern hemisphere, could not have been diverted towards filling this need in the southern sky.

Apart from this gap, which will have to be filled at some time, future work in radial velocities is likely to concentrate on refined observations of the brightest stars, on variables and peculiar objects, and on obtaining large numbers of velocities of fainter stars for statistical work. These last need not be of very great accuracy, although systematic errors will have to be carefully watched. There is in these three directions an almost unlimited field for large telescopes.

Obituary

MR. FRANK FINN

FRANK FINN, whose recent death, at sixty-four years of age, we regret to record, was an exhibitioner of Brasenose College, Oxford, and an excellent classical scholar. Whilst at Oxford he took a great interest in ornithology, both as an observer of birds and a systematic naturalist. He acquired a reputation amongst dealers and spent a great deal of his time in identifying collections of skins. This pursuit, unfortunately, occupied much of the time that he should have devoted to classics, with the result that his academic success by no means equalled his capacity. It may be said that this showed almost the leading defect in his character, which prevented him from being really successful in any of his undertakings. He

was always more interested in something which it was unnecessary to do at the time than in the immediate duty before him.

After taking his degree with honours in 'Greats', Mr. Finn went on an expedition to tropical Africa and spent a considerable time travelling, observing, and collecting. On his return he became assistant to Col. A. W. Alcock, who was then in charge of the Indian Museum. There also it was characteristic of him that he devoted more time to observing animals in the Zoological Gardens in Calcutta and its vicinity than to his official duties.

In 1903, Mr. Finn resigned his post and returned to England. The rest of his life was occupied by various minor appointments, none of which he cared to hold very long; by writing for the Press, and by writing books on natural history, the chief of which are: "Indian Sporting Birds", 1915; "How to Know the Indian Waders", 1906; "The World's Birds", 1908; "Game Birds of India and Asia", 1911; "Bird Behaviour", 1919; and with E. Kay Robinson, "Birds of Our Country". 2 Vols. 1922–23.

Mr. Finn had a most remarkable memory for facts, and there is no doubt that in his powers of observation and his real knowledge of birds and mammals, he had the making of a very great naturalist. For many years, however, he suffered from serious ill-health which made him irregular in his methods of working. He had, however, many delightful qualities and every naturalist who came intimately in contact with him had the highest possible appreciation of his knowledge and abilities.

WE regret to announce the following deaths:

Dr. Ernest Clarke, C.V.O., distinguished for his work in ophthalmic surgery, a manager and vice-president of the Royal Institution, on November 22, aged seventy-five years.

Mr. W. H. Patchell, consulting engineer, president of the Institution of Mechanical Engineers in 1924–25, on November 24, aged seventy years.

Mr. Charles M. Stuart, first headmaster (1888–1922) of St. Dunstan's College, Catford, who did much for the promotion of scientific method in education, on November 22, aged seventy-five years.

News and Views

Honour for Prof. Karl Pearson, F.R.S.

PROF. KARL PEARSON, of University College, London, has been awarded the Rudolf Virchow medal by the Berlin Gesellschaft für Anthropologie, Ethnologie und Urgeschichte. The award is made in recognition of Prof. Pearson's conspicuous services for the advancement of the study of human biology, and especially his pioneer work in the field of biometrics and his contributions to the study of eugenics, in which he has carried on and extended the work of the late Francis Galton. In conveying the announcement of the award, Prof. Eugen Fischer, president of the society, recalls the fact that up to the present the only recipients of the medal have been von der Steinen and Koch-Grünberg, the ethnologists; Olshausen and Heger, the archæologists; Toldt and Hans Virchow, anatomists; and lastly Erwin Baur, the geneticist. The value of the award is enhanced not only by its significance as a recognition of the international character of science, but also by the fact that on this, the first occasion on which the award has been made to a scientific worker outside the boundaries of Central European countries, the choice has fallen on one who is British. This, however, is not the only tribute which has been paid recently to the position in international scientific circles held by Prof. Pearson. The Sixth International Congress of Genetics, when assembled last summer in plenary session at Ithaca, New York, in conveying cordial greetings to Prof. Pearson and "best wishes for his health and long success and satisfaction in his scientific work", acknowledged the great indebtedness of the science of genetics to the statistical methods developed by him and now universally used.

To no one could these honours have fallen more appropriately. As Galton professor of eugenics in the University of London and as director of the Francis Galton Laboratory of National Eugenics, Prof. Pearson has attained a world-wide reputation for the originality and fertility of his application of statistical methods to the problems of biology and anthropology. His statistical methods have been developed in innumerable papers contributed to scientific periodicals and in a number of books, of which the "Grammar of Science" (1899) and "National Life from the Standpoint of Science" (1901) have exerted no inconsiderable influence on the development of scientific thought. These methods have been applied to the study of topics to which their adaptability would at one time have been inconceivable to any but the fertile genius of Francis Galton, whose life and letters were edited with discrimination and judgment by Prof. Pearson in three volumes (1914, 1924 and 1930). Yet notwithstanding the range and quality of his output, the great achievement of his fifty years teaching and work in London has been his success in inspiring and directing the work of others, for the most part his own pupils, who with him have contributed to the great advance in the exact scientific study of man and his heredity during the last generation. Prof. Pearson's success in this direction has been conspicuous in his editorship of *Biometrika*, a periodical for the statistical study of biological problems, which was founded by himself, the late W. F. R. Weldon and Sir Francis Galton. Happily, when Prof. Pearson retires from active teaching, as he proposes to do at the end of the current session, he will retain the editorship of this periodical.

The Furthest Depths of Space

THE theory of the expanding universe, which has lately attracted so much attention, formed the principal topic of Sir James Jeans's remarks in the Henry Sidgwick memorial lecture for 1932, which was given at Newnham College, Cambridge, on November 26, under the title "The Furthest Depths of Space". In a brief survey, Sir James introduced his listeners to the universe as we know it to-day, beginning with the naked-eye stars, then passing to the Milky Way system and from there to the extra-galactic nebulæ. These, in themselves objects of great importance, acquire additional interest as straws floating in the stream of space, showing how its currents are flowing. This space is curved, with a texture varying from the local irregularities which cause the electron to twist about in an electric or magnetic field, or the planets to move in curved orbits around the sun, to a bigger, coarser texture which makes space curve round on itself and finally close up. The state of curvature is not quite that of a universe in equilibrium as first conceived by Einstein, for later investigators, Friedmann, Lemaître and others have shown that such an equilibrium would be unstable. Space would immediately commence expanding or contracting with ever-increasing speed. We do not know what was the initial impulse which began the expansion. It may have been the starting of condensation in the primeval gas of which the universe is generally supposed to have consisted, but the suggestion, Sir James thinks, has not yet been strictly proved.

Expansion of the Universe

THE expansion of the universe expected by theory has been strikingly confirmed by radial velocity observations of the spiral nebulæ, which, we may remark, is discussed by Dr. R. O. Redman elsewhere in this issue (p. 836), but a serious difficulty immediately arises. The expansion is so fast that it cannot easily be reconciled with an evolutionary age of the universe greater than about 10^{10} years. Yet all other astronomical evidence requires an age of 10^{12} or 10^{13} years. The rate of expansion has been deduced theoretically by Eddington, who finds remarkable agreement with observation, at least so far as order of magnitude is concerned. If he can put his very daring calculations in a form which will command the general assent of mathematicians, they will provide a very strong confirmation of the whole theory of the expanding universe. Two other recent investigations have tried, in very different ways, to dispose altogether of the cosmical constant, the quantity which on Einstein's original theory fixed the amount of the large-scale curvature of the universe. Milne has supposed that the nebulæ were formerly bunched together in a quite small region of space and endowed with motions which have produced both their present distances and their present velocities. This does not solve the age difficulty and Sir James feels also that the simplicity of this explanation has been achieved by assuming practically all that is to be explained. On the other hand, the recent work of Einstein and de Sitter suggests that really we know no reason which makes space have any inherent curvature. There seems to be a possibility that the universe is undergoing a series of expansions and contractions, in which case we have all the time we want for its evolution. This appears to Sir James to be the only possibility at present in the field which is not exceedingly difficult to reconcile with our general knowledge of astronomy.

Crete and Mainland Greece

FURTHER evidence of the influence of Minoan Crete on the mainland of Greece after the fall of the Palace of Knossos was brought forward by Sir Arthur Evans in his lecture before the Hellenic Society on November 22. It has been derived from a number of inscriptions painted on vases discovered in a cellar by Prof. A. D. Keramopoulos, while excavating the Cadmeia of Thebes. These Sir Arthur has been allowed to examine and copy, and their publication has been reserved for him, by the Greek Archæological Society. The script, Sir Arthur said, answers in an overwhelming degree to that current in the latest phase of the Palace of Knossos as represented in more than 1,400 inscribed tablets. Out of about sixty signs gathered from the Minoan documents, no less than forty occur in the twenty-eight inscriptions from Thebes. In two instances the Theban inscriptions show the same signs as occur in the list of personal names in the inscription found at Knossos in 1902. Further, a comparison with the fragmentary inscriptions found on vases at Tiryns by the German excavators, and a few from Mycenæ, establish the identity of their script with that of Thebes. They also include a Knossian personal name. It may therefore be regarded as proved, Sir Arthur concluded, that in Mycenæan Greece of the fourteenth century B.C., the urban population spoke a language implanted from Crete, a language which in that island can be traced back to the third millennium B.C., and, if personal names count for anything, can be linked to the Carian races on the Anatolian side.

Marine Biology of the University of Sydney

DURING the past three years a scheme of oceanographic investigation has been initiated and conducted from the Department of Zoology of the University of Sydney, under the direction of Prof. William J. Dakin. The work commenced with an examination of the plankton and hydrographical conditions prevailing in the ocean waters off the entrance to Sydney Harbour. This is the first long-continued investigation of the plankton, that is, a study of the seasonal changes over a period greater than a year, to be made in Australian waters. In fact, little or nothing has been published regarding the seasonal changes in the plankton at any one station in the temperate waters of the southern hemisphere. The work has been greatly facilitated during the past year and a half by the acquirement of a small auxiliary yacht of about 12 tons (which has proved more suitable than a launch for ocean waters), and by the erection

of a Marine Biological Station at the entrance to Port Jackson, both being the property of the University. This biological station is at present the only one permanently equipped and in continuous use on the Australian coast.

Seasonal Plankton Rhythm

AT the recent meeting of the Australian and New Zealand Association for the Advancement of Science, it was stated by Prof. Dakin that plankton studies in New South Wales waters had shown a distinct diatom maximum in the spring, followed by a smaller maximum in the autumn. These conditions presented an interesting and close parallel with those so well known in the temperate waters of Europe. In further agreement a scarcity of plankton is recorded during the winter months and the planktonic Crustacea—*Copepoda* and *Cladocera*—rise to maxima in the early summer following the diatom and dinoflagellate maxima. The variations in the abundance of plankton during the year do not seem to be anything like so great as in the Irish Sea or English Channel, and it would almost appear as if the phosphate and nitrate concentrations in the sea water were also more uniform. The study of the relation between the seasonal rhythm of the plankton and changes in the physico-chemical environment is to be continued, whilst particular attention will be paid to the occurrence of fish eggs and larvæ.

Fisheries of the Philippines

THREE fully illustrated accounts of various Philippine fisheries are published in the July number of the *Philippine Journal of Science*, No. 3, vol. 48, 1932: "The Japanese Beam Trawl used in Philippine Waters", by Augustin F. Urnali; "The Fisheries of Lake Sampaloc, San Pablo Laguna Province, Luzon", by Florencio Talavera; and "Fishing Appliances of Panay, Negros and Cebu", by Florencio Talavera and Heraclio R. Montalban. Fishes of many kinds, shrimps and other Crustacea, molluscs and holothurians are all important commercially in the Philippines. In some parts the fishing is deteriorating from over-fishing, lack of attention, or from physical causes. New methods and restrictions are recommended by the different writers. The Japanese beam trawl is at present used only by Japanese, in their own boats, manned by their own men. It is apparently no more destructive than the other methods of fishing, and its use is advised for the native fishermen. Lake Sampalac, the largest of the nine crater lakes in the San Pablo Valley, was an important fishing centre before its height was lessened by approximately 10 metres. Now, partly from this alteration and partly from other causes which are investigated fully by Dr. Talavera, of the Division of Fisheries, Bureau of Science, Manila, the fishes are certainly decreasing, and legislative measures together with restocking are suggested. The shrimps in this lake appear to be inexhaustible. The multiplicity of terms used in the local fisheries and the names for the various appliances are astonishing, but these are all carefully explained and illustrated in the third paper.

Oceanography in Spain

IN June 1933 the first Iberian-American Oceanographical Conference will be held in Madrid. The Council, under the presidency of Prof. D. Odon de Buen of Madrid, was instituted in 1929 in order to facilitate co-operation between the Iberian Peninsula and parts of America, the countries involved being Spain, Argentina, Costa Rica, Ecuador, Salvador, Guatemala, Mexico, Panama, Peru, Dominican Republic, and Uruguay. The publications of the Council consist of a review (*Revista del Consejo Oceanografico Ibero-Americano*), which has been in existence for three years and contains many interesting short papers, and the memoirs (*Memorias del Consejo Oceanografico Ibero-Americano*), eleven numbers of which have been published, each containing one long paper. No. 9, by Prof. Rafael de Buen, deals with all the activities connected with the Spanish Institute of Oceanography, which was founded in 1914 to unite in one centre the coastal marine laboratories already in existence, situated in Palma de Mallorca, Malaga, and Santander. All these are now connected with the main oceanographical laboratories in Madrid, where all investigations are centralised, the director being Prof. Odon de Buen. Various expeditions have been undertaken, mainly in the Mediterranean, and in 1924 Spain joined the International Council for the Exploration of the Sea, among other things working out certain hydrographical problems round Cape Finisterre and studying the biology of the sardine and other fishes, including the hake, tunny, and bonito.

Tasmanian Rock Carvings

A DISCUSSION of the origin of certain alleged rock-engravings at Mersey Bluff, Devonport, Tasmania, appears in the *Papers and Proceedings of the Royal Society of Tasmania* for 1931. In its general bearing the paper is of considerable interest to archæologists and students of primitive art. Mr. A. L. Meston, who argues for the authenticity of the carvings, has examined and describes a number of them. He claims that he has identified representations of fish, coiled snakes, a bird's head, *Haliotis* shells, cup-and-rings, and concentric circles. The carvings are on horizontal surfaces of a hard diabase, and are not scratched but are incised, as if by a hard implement, such as a quartzite tool, impelled by a hammer. The existence of Tasmanian aboriginal carvings and drawings has been doubted, notably by the late H. Ling Roth; but Mr. Meston states that these examples have been accepted by those acquainted with primitive rock-carvings elsewhere. The case against the authenticity of these carvings is taken up by Mr. E. O. G. Scott, of the Queen Victoria Museum, Launceston, who has made an extensive and detailed report on the subject to the Museum Committee. A brief outline of his arguments appears in the *Proceedings*, pending decision as to publication in full. His conclusion is that the 75 rock-markings claimed by Mr. Meston to be carvings are not of aboriginal origin, but are items in an extensive series of natural erosions which have in general occurred along lines

of inherent pneumatological weakness in the Mesozoic region. He also suggests that rock-lichens have played a not unimportant part in the process of erosion of the grooves, and in some instances may have initiated them.

Mammoth Remains in New Jersey

IT is announced by the Academy of Natural Sciences of Philadelphia that five teeth and several fragments of bone of the mammoth (*E. primigenius*) have been discovered near Blackwood, New Jersey, twelve miles south-east of Philadelphia. The discovery was made in the course of work on the golf course of the Hidden Lake Country Club, and the remains were identified by Mr. Edgar B. Howard of the Academy's Department of Zoology. The teeth were found at a depth of 4 ft. within a small radius of what was once the bed of a fairly wide creek, now the bank of a streamlet. Each of the five teeth is fairly whole and one clearly shows the roots, of the size of a man's finger. In size the teeth range from 3 in. × 5 in. × 7 in. to 4 in. × 5½ in. × 9 in. and in weight from 3½ to 6¾ lb. each. The thin enamel ridges which traverse the chewing surface are still clearly visible. This constitutes the most impressive find of mammoth remains yet made in the eastern United States. Previously no more than a single tooth had been found in any one locality. Previous finds were at Trenton and North Plainfield, New Jersey, and five in Pennsylvania. In the Pleistocene epoch the mammoth had a distribution in North America ranging from Alaska, through British Columbia and the northern United States to the Atlantic, being a migrant by way of the Asiatic-Alaskan land-bridge from Siberia, where frozen specimens, complete with flesh, hide and wool, have been found in recent times. The fossils from Blackwood, with the tooth from Chadd's Ford, are now on exhibition in the museum of the Academy of Natural Sciences of Philadelphia.

Botany Collections at the Natural History Museum

THE Godman Trustees have presented to the Department of Botany of the Natural History Museum a collection of about six hundred plants made by Mr. R. C. N. Young in north-east Angola (Lunda). The Department is particularly rich in Angolan plants having valuable collections from F. Welwitsch and J. Gossweiler. The present set of plants is of considerable interest as it is from an area so far botanically unknown. Three octavo volumes of British plants have been presented by Miss Jackson. The interest in these is bibliographical, as there is a printed title page giving publisher's name and date (1847); there is also a printed preface. The title reads "Specimen Flora or British Botany exemplified by Plants from a Collector's Cabinet". The plants were "arranged by the author of 'The Pictorial Flora'" [Mary Ann Jackson].

Birds of Northumberland

FOR the third time the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne has published a catalogue of the birds of the district—P. J. Selby in 1831, John Hancock in 1874, and now, as a worthy successor, appears George Bolam's list of 1932. It appears as a special part (vol. 8) of the *Transactions* of the Society, and in order to avoid undue repetition, it takes as its datum line Mr. Bolam's own list of 1912, in his "Birds of Northumberland and the Eastern Borders". Hancock's catalogue included 255 birds for Northumberland, by 1912 the number had risen to 282, now the number well exceeds 300, and this largely because of the finer analysis of species and racial forms. Of course quite a considerable number of the birds in this or any other local list are no more than accidental visitors, the presence of which really means very little from a local point of view. Here, for example, the smew, with four records, takes more space than the swallow, martin, and sand-martin all added together; and yet fluctuations in the numbers of these summer visitors would be more worth recording than the odd occurrences of the winter duck. From a scientific point of view, the day of usefulness of the county list, unless it becomes an intimate and detailed chronicle of local changes and fluctuations, is past, and we venture to think that the third Northumberland catalogue of birds will be the last, notwithstanding its particular value and appeal to the people of the county itself.

Pest Control and Wild Animal Life

IN many parts of the United States of America the destruction of agricultural pests has become an intensified and highly specialised warfare organised by State departments. But it has scarcely been realised that the destruction is apt to reach far beyond the pests at which it is aimed. This would appear to be true particularly of large scale use of thallium and strychnine baits, the former of which is preferred at most seasons and in most areas because it makes 'better kills' than other types of poison. Dr. Jean M. Linsdale has collected further facts concerning losses to wild life in California from these sources, and summarises the reports of 285 observers who have found dead mammals and birds (other, of course, than squirrels and coyotes) unquestionably killed during pest control campaigns (*Condor*, vol. 34, p. 121; 1932). The list occupies 13 pages of the magazine, and it must be remembered that it covers, as a rule, only conspicuous species—many others must have passed unnoticed or unidentified. The author is of opinion that the accelerated development of pest control methods and their uninterrupted practice could so change the native bird life of California within a few seasons that all previous activities for its preservation would be nullified. The publication of these facts, however, should induce the authorities to reconsider their methods of pest destruction.

The Cinematograph as an Aid to Histology

A NEW reconstructional technique is put forward by Messrs. Peacock and Price in the September issue of the *Journal of the Royal Microscopical Society*. Successive photographs of the sections in a uniform series are taken on standard cinema film and after-

wards projected. It is found that an apparently continuous flow of the image on the screen can be obtained if about seven frames are exposed for each section. The camera is mounted between the microscope and a paper screen, sharp focus of the former being secured by exposing a number of frames at recorded settings of the fine adjustment; the camera is then swung out of the optical axis and the image brought to a sharp focus on the screen by means of a supplementary lens. The screen is now used to secure orientation and focus for each successive section, the camera being swung into the optical axis when a suitable adjustment has been obtained. Though much difficulty is at present occasioned through the distortion of successive sections during mounting, the new technique will prove a considerable aid both in teaching and in research.

Development of International Law

THE *New Commonwealth* (monthly, published at Mowbray House, Norfolk Street, Strand, W.C.2., price 6*d*.), the first issue of which has recently appeared, is the organ of a new international society formed to advocate the establishment of a world system of law and order. If "the common sense of all" is to "hold a fretful realm in awe", effective provision must be made for the administration of international justice, and this can be achieved only, in the new society's view, by establishing: (1) an international tribunal, to deal with all disputes threatening the peace of the world which do not at present come within the purview of the Permanent Court of International Justice; and (2) an international police force as the sanction of international law and a guarantee of security against aggression. On these two objectives the society proposes to focus and interest public opinion. As Sir Arthur Salter says in a letter to the editor, the times are dangerous and moral suasion alone cannot be relied upon to defeat the material forces of the world if these are all allowed to be harnessed to policies of evil. In an open letter signed by Norman Angell, Lord Cecil of Chelwood, the Archbishop of York, Sir Oliver Lodge, Prof. Gilbert Murray and sixteen other eminent citizens of nine of the principal countries of the world, the *New Commonwealth* is commended to all those who are interested in the development of the reign of law.

Production and Employment

IN a pamphlet entitled "The Prevention of Future Economic World Crises", Herr Robert Bosch of the Bosch Company, Stuttgart, points out that the present world-wide business depression differs radically from previous ones which were caused principally, if not exclusively, by a preceding unhealthy boom. He argues that the troubles of the present depression are not due to over-efficiency of production methods as commonly supposed but rather to the inefficiency and backwardness of non-technical branches of the world's activities. Foreign relations are handicapped by antiquated political and mercantilist conceptions leading to armaments and tariffs while national prosperity is handicapped by wasteful and inefficient administration and distribution and by antagonism between different groups of society. It is necessary to write off superfluous plant capacity so that the remaining factories may be run efficiently. Herr Bosch visualises a reduction of the yearly working time to 1800 hours or less in place of the present 2400 hours so as to guarantee some employment at fair compensation to every worker, but he recommends that the rigid eight-hour day should be replaced by more flexible arrangements so as to provide the maximum economy in the operation of particular factories.

Scientific Treatment of Delinquency

A NEW era in the investigation and treatment of crime was outlined at an inaugural meeting of the 'Institute for Scientific Treatment of Delinquency' held at University College, London, on November 29. The chairman, Dr. Edward Glover, pointed out that existing criminal and penal codes differ in no essential respect from the behaviouristic codes spontaneously evolved by two-year old children. He emphasised the urgent need for centralisation and co-ordination of effort at present made by small independent organisations. In his opinion any research on the subject should be conducted in an attitude of complete detachment from preconceived views as to desirability. The need for such an Institute was emphasised by a number of speakers. Amongst these, Lord Feversham dealt with the problem from the point of view of adequate probationary handling. Drs. Hadfield, Rees and Emanuel Miller recounted medico-psychological experience of handling delinquents at various clinics and welfare centres. The points of view of general science, ethics and politics were presented by Prof. Winifred Cullis, Canon Donaldson and W. J. Brown respectively. The Institute's immediate plans for co-ordination research, treatment and technical instruction were then outlined by Dr. Glover. It is hoped that within a short time a reasoned report on the present system of criminological work may be put before the various Government departments concerned. All communications should be addressed to the honorary secretary of the Institute, 56 Grosvenor Street, London, W.1.

The Study of an Oilfield

SOME observations on this subject were made by Mr. J. W. Weil in a paper read before the Institution of Petroleum Technologists on October 11. The paper was perhaps timely as representing the case for petroleum geology taking its logical place in the systematic scheme of oil production. Latterly there has been a decided tendency to interpret underground reservoir conditions—even geological data—on the basis of such functions as flowing pressures, oil and gas measurements, gas-oil ratios and other physical determinations which have been advanced as part of the standard technique of production engineering. The author pleads, and rightly so, for a thorough geological investigation as precedent to oilfield development and, in this connexion, he stresses the necessity of adequate study of stratigraphy, structure, factors influencing the accumula-

tion of oil and gas, data necessary for correlation of horizons and the construction of stratigraphical and production maps. While there is clearly nothing strikingly new in this communication, the paper will have done good if it directs the attention of those primarily concerned to the fact that, while geology may be substantially aided by the applications of its contact sciences, its principles as governing the understanding of sub-surface oil pools can never be superseded.

Mining Research at Birmingham

THE Executive Board of Mining Research of the University of Birmingham has issued a report on the work of the Mining Research Laboratory for the year 1931. The Laboratory receives grants from the British Colliery Owners' Research Association, the Department of Scientific and Industrial Research, and the Miners' Welfare Fund, which supports work in connexion with the problems of safety in mines. The report bears witness to the wide range of sciences—physics, chemistry, geology, and physiology—which are focused upon the problems of the coal industry. Much attention continues to be given to spontaneous combustion, as underground heatings are a prolific source of danger and accident. For some years the Laboratory has examined the hydrogenation of coal. While this problem has come to be regarded as technically solved, economic success seems to be so remote that the work has been suspended. Attention is being turned to problems connected with the use of compressed gas for road transport.

Social Conditions of Miners in India

THE September part of the most recent volume of the *Transactions of the Mining and Geological Institute of India* contains an important paper by Mr. R. R. Simpson, chief inspector of mines in India, upon the social conditions of miners in India, together with an animated discussion upon it. The paper is particularly interesting in itself, and all the more so because it discusses in detail a number of the very numerous recommendations made by the Royal Commission sent out in 1929 to inquire into Indian labour conditions, which made its report in 1931. The members who discussed the paper expressed varying views, and evidently looked upon Mr. Simpson's paper as a peg on which to hang the discussion of the recommendations of the Royal Commission. The paper and discussion occupy considerably more than fifty pages, and, therefore, do not lend themselves to any ready abstract, but both are well worth careful study on the part of those who wish to understand thoroughly Indian labour conditions.

Exhibition of Chemical Plant at Cologne

"ACHEMA VII", the seventh exhibition of chemical plant and equipment organised by the Deutsche Gesellschaft für chemisches Apparatewesen ("Dechema"), is to be held at Cologne on June 2–11, 1933. Similar exhibitions have been held since 1920 in Hanover, Stuttgart, Hamburg, Nürnberg, Essen, and Frankfurt-am-Main. The exhibition next year will be associated with meetings of the Verein deutscher Chemiker and other technological associations, in particular the Deutsche Brennkrafttechnische Gesellschaft and the Deutsche Kautschukgesellschaft, and with a Rubber Exhibition which will form the summer exhibition of the city of Cologne and will remain open until October 1933. The three principal halls around the congress hall in the Rheinpark will contain examples of acid-proof stoneware and other ceramic products, technical instruments for measurement and control, non-metallic and non-ferrous plant, laboratory apparatus and instruments, and machinery, with examples of complete plant and processes, raw materials and products. The rubber section will illustrate historically the development of methods for the production of rubber and of its industrial applications. An exhibition of such character will necessarily attract international interest, and nowhere more than in countries where chemical industries and the manufacture of chemical plant have reached a high standard of attainment. Particulars of the exhibition can be obtained from "Dechema", Seelze, near Hanover.

Mosquito Control

UNDER the title of "A Mosquito Summary", Mr. John F. Marshall, director of the British Mosquito Control Institute, Hayling Island, Hants., has recently issued an illustrated pamphlet of an essentially practical character. In a short and concise manner it explains how to recognise a mosquito, how such insects breed and how to distinguish anophelines from culicines in all stages of life. The manner in which mosquitoes carry disease and methods of controlling these insects are also summarised. The pamphlet, which is obtainable from the Institute (price 9*d*.) should prove useful to health officers and others concerned with mosquito eradication.

Dairy Research

WE have received the annual report for the year ended July 31, 1931, of the National Institute for Research in Dairying at the University of Reading. In common with other Institutions, a restricted income has necessitated a percentage reduction upon all salaries and wages and a curtailment of research work, the Government's grants for 1931–32 being less than previously by nearly £2,000. An account is given of the work of the various departments, with brief abstracts of scientific contributions made by the staff. An obituary notice, with portrait, of the late director, Dr. Stenhouse Williams, is included.

Bishop's Ring and the Andean Eruption

MR. J. FRASER PATERSON, writing from Broken Hill, Australia, says :—"The rare phenomenon known as Bishop's ring was visible in the western sky at 5 P.M. on Saturday, July 23. This date is about ten and a half weeks after the Andean eruptions. The colour of the ring was sepia."

Announcements

PROF. DAVIDSON BLACK, professor of anatomy in the Union Medical College, Peking, will deliver the Croonian lecture of the Royal Society on December 8. The title of Prof. Black's lecture will be "The Discovery of *Sinanthropus*".

UNDER the Order in Council dated February 6, 1928, the Lord President of the Council has appointed Dr. T. Franklin Sibly, Vice-Chancellor of the University of Reading, to be a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

THE following officers and new members of council of the London Mathematical Society have been elected for the session 1932-33: *President:* Prof. A. C. Dixon; *Vice-Presidents:* Prof. S. Chapman, Prof. H. Levy, Mr. T. L. Wren; *Treasurer:* Dr. A. E. Western; *Librarian:* Prof. H. Hilton; *Secretaries:* Prof. G. N. Watson, Mr. F. P. White; *New Members of the Council:* Prof. J. C. Burkill, Mr. W. L. Ferrar, Prof. E. A. Milne, Prof. G. F. J. Temple, Prof. E. C. Titchmarsh.

A CONFERENCE is being called by the Building Research Station of the Department of Scientific and Industrial Research to consider proposals for the establishment of a fire testing station for the building industry. The conference will be held at the Institution of Civil Engineers on Wednesday, December 7, at 11 A.M., under the chairmanship of Sir Clement Hindley. Firms and bodies which have not received invitations to the conference direct, but wish to send representatives, should communicate with the Director, Building Research Station, Garston, Watford, Herts.

THE annual Congress of the British Institute of Radiology will be held at the Central Hall, Westminster, on December 7-9, under the presidency of Prof. F. L. Hopwood. The Congress will be officially opened by Sir George Newman on December 7. In connexion with the Congress an exhibition of X-ray apparatus will be organised by the British X-ray industry. The thirteenth Mackenzie Davidson memorial lecture will be delivered by Dr. J. Chadwick on "The Neutron" and the fifteenth Sylvanus Thompson memorial lecture by the Right Hon. Viscount Lee of Fareham on "Radium as a Therapeutic Agent—The Case for National Control". The papers will be divided into medical, and physical and technical sessions.

THE attention of biologists may be directed to the Peking Natural History Society's *Bulletin* now in its seventh volume. This journal is doing good work in publishing illustrated papers on the fauna, flora, general biology, etc., of China. Its trend is largely zoological and through the medium of its pages additions to the fauna of China are frequently made known. The majority of the contributions are written in English by Chinese investigators, while there are occasional papers by European and other specialists. The editor of the *Bulletin*, to whom contributions and requests for exchange should be addressed, is Dr. Chenfu F. Wu, Department of Biology, Yenching University, Peiping, China.

THE Ministry of Agriculture and Fisheries has issued new editions of three advisory leaflets, dealing respectively with "Cleanliness in Dairying" (No. 140), detailing the causes and prevention of contamination of milk, "Caerphilly Cheese" (No. 141) and "Cheshire Cheese" (No. 142), the last two describing the manufacture of these cheeses. The leaflets cost 1*d*. each, and are published by H.M. Stationery Office.

WE have received from Messrs. Watson and Sons (Electro-Medical) Ltd., 43 Parker Street, Kingsway, London, W.C.2, a copy of a booklet and folder describing a new X-ray outfit for dental work, the "Sunic" Mark III shockproof unit, which, as its name implies, is claimed to afford complete protection from electrical as well as X-ray dangers. The booklet also gives a simple account of X-rays and their production.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A temporary mistress to teach principally arithmetic and geography at the Aston Junior Commercial School—The Chief Education Officer, Higher Education Department, Education Office, Margaret Street, Birmingham (Dec. 5). A civilian photographic officer at the Royal Air Force School of Photography, Farnborough—The Air Ministry, Adastral House, Kingsway, W.C.2 (Dec. 10). A temporary demonstrator in the Department of Biochemistry at the University of Liverpool—The Johnston Professor of Biochemistry, The University, Liverpool (Dec. 12). An assistant director of examinations in the Civil Service Commission—The Secretary to the Civil Service Commissioners, 6, Burlington Gardens, London, W.1 (Dec. 31). Examiners for scholarship and staff examinations of the London County Council, in scientific and other subjects—The Education Officer (G.P.1), County Hall, Westminster Bridge, London, S.E.1 (Jan. 2). A cartographer in the Hydrographic Department of the Admiralty—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (Jan. 12). A Hope professor of zoology (with special reference to entomology) at the University of Oxford—The Registrar, University Registry, Oxford (Jan. 21). A technical assistant for the Public Health Laboratory at Salisbury, Southern Rhodesia—The Official Secretary to the High Commissioner for Southern Rhodesia, Crown House, Aldwych, London, W.C.2. A professor of horticulture at the University of Reading—The Registrar. An assistant lecturer in the Department of Physics at the Battersea Polytechnic, London, S.W.11—The Principal.

ERRATA.—In NATURE for October 29, p. 646, column 2, line 10, for "Sir Robert Boyce" read "Sir Rubert Boyce". In NATURE for November 19, p. 780, Research Item entitled "New Thermophilic Organisms", for "Bax" read "Dax" throughout.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Redwoods of California

As one who once lived in the Redwood country, may I be allowed to thank the Master of Downing for his vivid pen picture in NATURE of November 12 of those inspiring monuments of the past, the Californian Redwoods ?

A few years ago, when camped in a Redwood grove, I was sleeping at night on the stump of a huge tree, felled perhaps in the early days of settlement. A ring of young coppice probably not less than 100 ft. high, growing out of the stump, formed a charming screen, among the branches of which the blue jays chattered and the Californian thrush poured out his cheerful evensong. Looking upward as we lay in bed, the stars could be seen twinkling through the openings of a sky-pattern akin to that shown in Dr. Cannon's excellent photograph. But at intervals of a few nights, the sky would be enveloped in a cold, grey fog; this condensed in the foliage of the tall spires and fell in a shower so heavy and continuous that unless our beds had been covered with waterproof they would have been wet through.

The ground beneath the Redwood is normally clothed with a layer of decaying foliage three to five inches, and sometimes even a foot, in depth; this is composed chiefly of Redwood leaves still attached to the branchlets on which they grew, for *Sequoia sempervirens* sheds its branchlets, though unlike the related swamp cypress (*Taxodium*) or the larch (*Larix*) it does not become leafless at any season.

An examination of the layer of dead leaves showed that although it was the 'dry' season of the year, the layer was wet through by the fog-drip from the branches above; into this spongy mass the Redwood had developed a dense system of rootlets, many being obviously young and in vigorous growth, some of them definitely growing upwards from the horizontal roots into the mass of humus above; doubtless the tree was drawing therefrom a supply of moisture and of plant food.

This constant renewal of food supply and moisture near to the base of the trunk, and the ability to renew, as it were, its root system at close range, may have something to do with the remarkable longevity of the tree. They explain, also, how the sea-fog compensates for lack of rainfall in the long, hot, rainless summer of California. But they suggest a serious menace to the continued existence of these magnificent relics of a former flora, in the treatment they are receiving—or were then receiving—at the hand of man. With a commendable desire to prevent forest fires, it was customary for the custodians of public camping grounds in the National, State, or County groves, to sweep the ground beneath the Redwoods quite clear of dead leaves. As these surface-rooting trees appear to depend for their water supply during a not inconsiderable part of the year on the moisture stored in the layer of decomposing foliage, it is probable that the sweeping bare, and subsequent consolidation, of the soil, checks the development of the superficial system of new roots, and causes too rapid evaporation of the much-needed summer moisture, from the soil surface. Though in some years the sea-fogs may continue for weeks at a time, they are often discontinuous, lasting about three days together, separated by more or less equal spells of hot, dry weather with almost cloudless skies, resulting in intense evaporation of moisture from a hard, bare, soil surface, though with comparatively little loss from a loose spongy mulch.

These facts explain the limitation of the Redwood to that narrow belt (averaging about twenty miles in width), which is watered by sea-fog in the rainless season, just as the evergreen rain-forest of Central and South Africa is limited to the 'mist-belt' of the eastern mountain chain. They may explain, also, the behaviour of the Redwood in certain parts of England, where it often has a shabby, unhealthy appearance though in other localities it is vigorous and apparently quite at home with its environment. In my garden there are both a young Redwood and a young "Big Tree" (*S. gigantea*); each has developed a set of rootlets near the soil surface. Noticing, last summer, that both trees showed signs of check in growth and some die-back of foliage, the Santa Cruz observations came to my mind, and treatment with a thick mulch of rotting grass and leaves (left on throughout the summer and renewed in winter) was tried; the beneficial effect was quickly noticeable. Late last spring the gardener, when tidying up, cleared the mulch from the Sequoias; during a warm dry period in early summer the trees again showed signs of suffering; the prompt application of a fresh mulch had almost immediate effect, followed by a steady growth of new wood equalling that of trees of the same age in their native haunts.

From these observations it would seem likely that in the drier parts of England, on gravelly or sandy soils, the Redwood would benefit from a mulch of leaves or rotting grass, especially during the drier summer months, and that this treatment might be applied with advantage to old-established trees as well as to young ones. If this surface-rooting habit is of regular occurrence in the species, such a mulch would afford protection to the roots against frost also. In fact, the desirability of maintaining a constant mulch under Sequoias seems to be indicated.

J. BURTT DAVY.

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Oxford.

Heterogony and the Chemical Ground-Plan of Animal Growth

IN 1924 in this journal, Huxley[1] first considered the relation between the growth of parts in a living organism, when the parts increase or decrease in relative size. The equation

$$\log y = \log b + k \log x$$

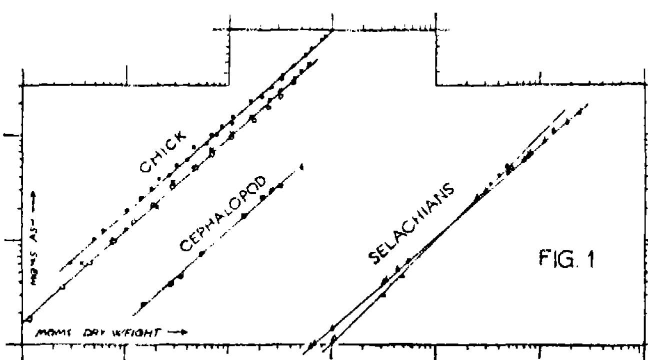
describes the process, where y is the size of the part, x the size of the whole, and b and k are constants (the former giving the fraction of x which y occupies when x is unity, and the latter the ratio of the growth-rate of the part to the growth-rate of the whole). Thus on a double logarithmic grid, straight lines are obtained, the slope of which is determined by the constant k, and the absolute position of which relative to the axis values, by the constant b. Since Huxley's first paper, this simple relation has been abundantly verified for morphological magnitudes in a large number of

animals, vertebrate and invertebrate, as described in his recent book.[2]

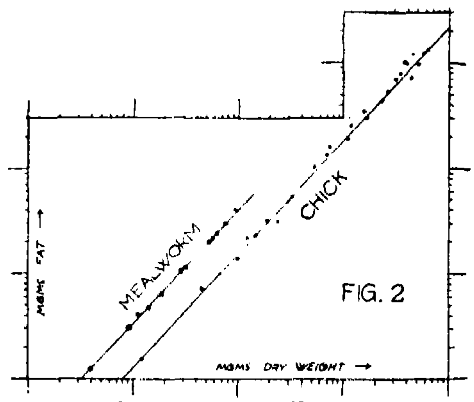
It seems likely, however, that the value of these considerations will be found to be just as great for the biochemist as it has been for the anatomist and the zoologist. I have recently undertaken a study (to be published *in extenso* in the *Bulletin de la Société Philomathique de Paris*) of the chemical heterogony of developing embryos, and have extended it to include a number of sets of data covering the whole range of the life cycle in certain animals. For the development of an embryo, the chick, for example, the plotting of chemical entity against chemical totality (such as non-protein nitrogen against dry or wet weight) on the double logarithmic scale, gives almost without exception a straight line. In certain cases, the data seem to demand representation by two or even three successive straight lines, periods of positive or negative heterogony being followed by periods of isogony, or vice versa. It is not, however, upon these critical points that emphasis should, it seems to me, be placed, for closer statistical analysis or the availability of more accurate data, may show them to be artifacts. What does seem important is that in many cases, the slope of the straight line for a given substance or group of substances, is identical or very similar in widely different organisms. Thus in Fig. 1 the total ash is shown plotted on a double logarithmic grid against the dry weight for the embryos of chick, cephalopod, and some selachian fishes. In spite of the great differences in absolute weights and times, the heterogony is the same ($k=0 \cdot 89$ for the chick, $0 \cdot 86$ for *Sepia*, and $0 \cdot 91$ for the selachian fishes). Fig. 2 shows the fat of the chick embryo and the mealworm larva plotted in the same way. Again, the heterogony is the same ($k=1 \cdot 06$ for the chick, $1 \cdot 07$ for the mealworm).

This similarity of chemical development between different animals appears in numerous other instances: (1) water content of mammals, reptiles, birds, amphibians, fishes, cephalopods and arthropods throughout the life cycle, (2) nuclein content of chick and mammals, (3) dry substance of various mammalian brains, (4) proteins, phosphatides, cerebrosides, sulphatides, cholesterol, and extractives, of the brains of rat and man, (5) calcium in chick and mammals. The evidence on which these instances are based will be found in the paper referred to above.

In plotting chemical magnitudes heterogonically we 'short-circuit' time. In comparing the heterogonic plots of the same constituent of different organisms we abstract (*a*) from the morphological form, (*b*) from the nutritional factors, (*c*) from the absolute values of the magnitudes, (*d*) from the time taken to perform the work shown on the plot. We have nothing left but a system of relations or ratios, which may be the same in all animals, and seems certainly to be the same in many animals—in a word, a fundamental chemical plan of animal growth. Just as D'Arcy Thompson[3] could transform one actually existing morphological shape into another by systematic deformations of Cartesian co-ordinates, so the chemical ground-plan must be thought of as deformable in space-time. It is probable that the essential processes of growth proceed in all animals, whatever their form and size, according to a definite plan recognisable in the chemical constitution of the organism at any given stage of its life history.



● *Gallus domesticus* (Bishop); ○ *G. domesticus* (Murray); × *G. domesticus* (Romanov); ✱ *Sepia officinalis* (Ranzi); △ *Scyllium canicula* (Ranzi); ♠ *Torpedo ocellata* (Ranzi); + *Torpedo marmorata* (Ranzi); δ *Mustelus vulgaris* (Ranzi).



● *Gallus domesticus* (Murray, Cahn and Romanov); ✱ *Tenebrio molitor* (Teissier).

JOSEPH NEEDHAM.

Gonville and Caius College,
Cambridge.

[1] Huxley, J. S., NATURE, 114, 895, Dec. 20, 1924.
[2] Huxley, J. S., "Problems of Relative Growth", London, 1932.
[3] D'Arcy Thompson, W., "Growth and Form", Cambridge, 1917.

Radioactivity of Samarium

THE discovery that the radioactivity of potassium is due to a minor isotopic constituent, suggests the idea that other common elements may also have radioactive isotopes present in small amounts. This line of thought induced us to investigate the properties of samarium and we found this element to be markedly radioactive.

The activity of samarium oxide is a third of that of a thick layer of potassium chloride of equal surface. It is not due to the presence of any known radioactive element. This follows partly from the fact that efforts to separate the activity by precipitation with barium, lead, zirconium and so on failed and partly from the properties of the radiation emitted. The intensity of the latter is decreased to half its value by a thickness of aluminium of $1 \cdot 3$ μ. Measurements made by the method of Geiger and Klemperer indicate that the radiation is of the α-ray type.

This kind of radiation has not previously been

known. The close vicinity of samarium to the presumably very rare element 61 suggests that the activity may possibly be due to the presence of the latter. However, preparations of samarium so far investigated, mostly kindly given to us by the late Baron Auer von Welsbach and by Prof. Rolla of Florence, all show the same activity.

G. HEVESY.
M. PAHL.

Institute of Physical Chemistry,
University of Freiburg im Breisgau.

New Isotopes of Mercury

IN the course of some tests with very sensitive Schumann plates supplied by Messrs. Adam Hilger, I have obtained mass-spectra of mercury of an intensity greater than any previously photographed. On the best of these there are unmistakable traces of two new lines 197 and 203. The first is certainly due to a new isotope. The chance that the second is a hydride of the strong line 202 is considered small, for the conditions were unfavourable to the formation of hydrides, while under very favourable conditions in previous experiments no trace of the line had been seen. Their abundance was estimated by comparison with the faint isotope 196 previously determined to be present to the extent of 0·10 per cent. Assuming this figure, photometry indicated that 197 and 203 were present roughly to the extent of 0·01 and 0·006 per cent respectively. Their effect on the mean atomic weight will therefore be quite negligible.

F. W. ASTON.

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Nov. 19.

Monoacetone Hexuronic Acid

TWENTY grams of hexuronic acid, prepared by Svirbely and Szent-Györgyi, were shaken in 500 c.c. of acetone in the presence of 50 grams of anhydrous copper sulphate for twenty-four hours. After filtration, the fluid was evaporated *in vacuo* to one third of its volume. On addition of a double volume of petroleum ether the monoacetone derivative of hexuronic acid crystallises out in well-formed large, colourless prisms or long needles. These were dissolved in acetone and recrystallised by the addition of petroleum ether. Seventy per cent of the theoretical yield was obtained.

The same substance was obtained when five per cent sulphuric acid was added to the acetone solution of hexuronic acid. After standing overnight, the sulphuric acid was removed by anhydrous sodium carbonate. Further treatment as above gave a yield of fifty per cent.

The acetone derivative is freely soluble in water, methyl and ethyl alcohol and pyridine, less freely in acetone or ether, insoluble in petrol ether or benzene. The melting-point is 220°–222° C. with decomposition. It causes a big depression of melting-point in hexuronic acid (melting-point of hexuronic acid 192° C.). The aqueous solution of the substance reduces silver nitrate, Fehling's solution, and iodine in the cold. The equivalent weight, estimated by iodine titration, is 107; the molecular weight is thus 214 (calc. 216). Analysis gives:

	Experiment.	Theoretical.
Carbon	49·82 per cent	49·9 per cent
Hydrogen	5·90 ,,	5·6 ,,

The specific rotation of hexuronic acid, and the monoacetone derivative, are (at 20° C.):

	Hexuronic acid.	Monoacetone Hex. Ac.
In water	+ 24 (C, 1·0)	+ 20 (C, 1·04)
In abs. ethyl alcohol	+ 58 (C, 1·03)	+ 15 (C, 1·02)
In abs. methyl alcohol	+ 50 (C, 1·0)	+ 28 (C, 1·03)

The acetone derivative is readily decomposed by water into acetone and hexuronic acid, which latter substance can easily be recovered quantitatively. Accordingly, dissolved in water, the molecular rotations of hexuronic acid and of its acetone derivative were found to be the same (actually 4224 and 4321 respectively).

This investigation has been aided by a grant from the Josiah Macy, Jr., Foundation.

L. v. VARGHA.

Institute of Medical Chemistry,
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Oct. 30.

Thermo-Optical Dissociation of Sulphur Dioxide

THE absorption spectrum of sulphur dioxide vapour in the far ultra-violet, which has been investigated by Henri[1] and Wieland between 2,500 and 2,000 A., has now been extended up to 1,700 A. by means of a 2 metre vacuum spectrograph. The analysis of the bandheads will be published in a later paper. Here I am discussing a dissociation process connected with this band spectrum.

The rotational structure of the SO_2 bands disappears gradually at about 1,900 A. This limit of pre-dissociation corresponds to a dissociation of SO_2 into SO + O + kinetic energy, as has been shown by Franck, Sponer and Teller[2]. Now there is no sign of dissociation at room temperature, obviously because the dissociated products recombine instantaneously. But at a temperature of 450° C. and a pressure of 1·5 mm. the absorption spectrum changes completely. The SO_2 bands are replaced by two quite different band systems, a faint one between 2,850 and 2,570 A., which is identical with the well-known S_2 bands, and a strong one between 1,800 and 1,650 A., which does not seem to have been known before, but which very probably also belongs to S_2 (the combinations demand a vibrational frequency of 725 cm.$^{-1}$ in the ground state). At the same temperature and a somewhat higher pressure of 4·5 mm. both the SO_2 bands and the S_2 bands are visible. After recooling the absorption tube at 20° C. the spectrum shows the unchanged SO_2 bands alone as before heating.

These results suggest a dissociation of SO_2 into $\frac{1}{2}S_2 + O_2$. (The absorption spectrum of O_2 at a pressure of 1 or 2 mm. is too faint to be observed in a 5 cm. tube.) Now a purely thermal dissociation of SO_2 requires an energy of 83 kcal. (or 3·6 electron-volts) (SO_2 + 251·5 kcal. = $\frac{1}{2}S_2 + O_2$ + 168·7 kcal.) and consequently cannot be caused by raising the temperature to 450° C. only (energy of thermal agitation 0·03 electron-volts). On the other hand, an optical decomposition requires 6·5 electron-volts, if the dissociation process takes the following course:

$$SO_2 + 6{\cdot}5 \text{ electron-volts (predissoc.)} = SO + O + 0{\cdot}9 \text{ electron-volts (E kinet.)}.$$
$$SO + 5{\cdot}1 \text{ electron-volts (predissoc.)}^3 = S + O.$$

But although the light of the hydrogen lamp is photochemically active below 1,900 A. (6·5 electron-volts) it does not have any appreciable decomposing effect on SO_2 at room temperature. Thus a combined thermo-optical effect only can be responsible for the

observed dissociation. Such an effect can perhaps be understood from a theory on the predissociation of polyatomic molecules, as has been pointed out by Franck, Sponer and Teller[2]. According to these authors the spectral range of predissociation (which is identical with the range of the photochemically active light) even if quite small at low temperatures, can extend very much with increasing temperature. Thus at a high temperature the light of the hydrogen lamp, being photochemically active over a much wider range than at room temperature, could produce an appreciable decomposition of SO_2.

A more detailed paper on this subject will appear shortly.

K. WIELAND.

H. H. Wills Physical Laboratory,
University of Bristol.

[1] *Leipziger Vorträge*, 1931, p. 131.
[2] *Z. phys. Chem.*, B, **18**, 88; 1932.
[3] Martin and Jenkins, *Phys. Rev.*, **39**, 549; 1932.

'Protective' Adaptations of Animals

ON the subject of "ant-mimicry" Mr. Uvarov states[1] on McAtee's authority, "that more than three hundred species of American birds (out of the total number of about eight hundred species including non-insectivorous ones) feed on ants and some of them consume thousands of individuals." He does not seem to have noticed the consequences of McAtee's method in tabulating "the total number of identifications . . . from these stomachs, counting those of whatever degree, once for each time identified, irrespective of the number of individual specimens concerned"[2] (p. 7). Therefore a bird's stomach containing a single ant or a very small number, liable to be swallowed accidentally with other food, would lead to the obviously absurd conclusion that the bird feeds on ants. A woodpecker's stomach containing 2,000 ants (p. 93) supplies evidence which, on this system, is of no greater value than a stomach containing a single ant. It is much to be regretted that McAtee, with all this vast material before him, did not publish all the available data which would have enabled us to know more of the real and habitual enemies of ants as well as of other insects. Mr. H. B. Cott has done this work admirably in his paper[3] on the tree-frogs of the Lower Zambezi. Here we are given incontrovertible evidence that certain species regularly feed upon these powerful and aggressive insects. But who doubts that they have many enemies? Yet it will, I think, be clear to anyone who reads Mr. C. Elton's interesting paper[4] on "Territory among Wood Ants", that insects mistaken for ants in Dr. T. G. Longstaff's bird sanctuary at Picket Hill would, on the whole, be benefited by the resemblance and that the chance of being eaten as an ant by the green woodpecker would be a risk well worth taking.

Those who maintain with Mr. Uvarov that because ants have many enemies there can be no advantage in the mimicry of ants might with even greater force argue[5] "that the danger would far outweigh the advantage of the well-known longitudinal stripes and green colour borne by grass-feeding larvæ". Think of the larger mammalia whose existence is bound up with the grasses. How dangerous to resemble grass when such quantities are eaten at a single meal by these huge animals!

So far from the following line of argument, advanced in 1898,[6] bearing the "aspect of a beautiful fairy-tale" I believe that it is reasonable and will not be lightly dismissed. "When one insect resembles an ant by the superficial alteration of its whole body-form, another by the modifications of a shield-like structure which conceals its unaltered body, another by having the shape of an ant painted, as it were, in black pigment upon its body while all other parts are concealed [by colour]; another by a further modification of its body, so that it represents not an ant only, but the object which the ant is almost always carrying—when the effect of all these results is heightened by appropriate habits and movements, we are compelled to believe that there is something advantageous in the resemblance to an ant, and that natural selection has been at work".

I certainly did not allege in a former letter[7] that Mr. Uvarov had willingly misrepresented the opinions of others. On the contrary, I expressed the conviction that he would *not* willingly do so. Nevertheless his statement, "taken almost verbatim from the original paper", that "A common objection to this [McAtee's] method is that anything found in a bird's stomach would be in an unrecognisable state" is inaccurate and misleading. This supposed "common objection" is not the only rash and incorrect statement or inference in McAtee's paper. Others were criticised at the International Congress of Entomology in Paris last July in a paper which will appear in the forthcoming volume of *Proceedings*. Fellows of the Entomological Society of London and their friends will have the opportunity of hearing further criticisms at the meeting of December 7.

I trust that those who are interested in these important and far-reaching questions will carefully study Dr. F. Morton Jones's paper on "Insect Coloration and the Relative Acceptability of Insects to Birds", which will appear in the forthcoming part of the *Transactions of the Entomological Society of London*.

I cannot conclude without commenting on one other statement in Mr. Uvarov's letter. Referring to the "great problem of natural selection", he writes—"it is time that attempts were made to elucidate it by an unbiassed accumulation of facts". He does not appear to know that one of the greatest problems of natural selection, forming the subject of this correspondence, has been elucidated, and successfully elucidated, by the careful and unbiassed observations of many naturalists, during the past thirty-six years. I need only mention G. A. K. Marshall,[8] C. F. M. Swynnerton,[9] and G. D. Hale Carpenter[10]—naturalists whose work has been undervalued or altogether neglected by McAtee, and now by implication in the above-quoted sentence by Mr. Uvarov.

EDWARD B. POULTON.

Oxford University Museum.

Nov. 11.

[1] NATURE, vol. 130, p. 697, Nov. 5, 1932.
[2] Smithsonian Miscellaneous Collections, vol. 85, No. 7, Washington, 1932.
[3] *Proc. Zool. Soc. Lond.*, p. 471; 1932.
[4] *Journal of Animal Ecology*, Vol. 1, No. 1, p. 69, May 1932.
[5] *Zoolog. Anzeiger* (Wasman-Festband), 1929, Akademische Verlagsgesellschaft m.b.H., Leipzig, pp. 79-86.
[6] *Linn. Soc. Jour.,—Zool.*, vol. 26, p. 595; 1898. Figures illustrating the diverse methods by which the resemblance is produced are given on pp. 589-594
[7] NATURE, vol. 130, p. 202, Aug. 6, 1932.
[8] *Trans. Ent. Soc. Lond.*, pp. 287-584; 1902.
[9] *Linn. Soc. Jour.,—Zool.*, vol. 33, pp. 203-385; 1919.
[10] *Trans. Ent. Soc. Lond.*, pp. 1-105; 1921.

Delayed Split and Pairing of Chromosomes at Meiosis

SOME recent claims in connexion with the cytological explanation of meiosis raise very important questions when taken in conjunction with morphological development. This matter is brought to a climax by the recent report in NATURE of a paper read by Prof. C. L. Huskins[1] to the Royal Society of Canada.

Until recently, pairing in meiosis was generally considered to be due to the occurrence of two sets of like chromosomes, one set from each parent. Cytological study of triploids, tetraploids, etc., and of the detailed structure of chromosomes during pairing caused doubt to be thrown on this interpretation. Evidence and conclusions from it were discussed by Darlington[2] in NATURE. He points out that the threads first discernible in the prophase of mitosis are paired (pairs of chromonemata), whereas in meiosis they are single (chromosomes) but later come together in pairs and, still later, split. Then he states the chiasmatype theory of meiosis, that the pairing of chromosomes (not chromonemata, as in mitosis) is due to a delayed splitting and that the immediate cause of pairing is the chiasmata. The following are quotations from the article referred to:

(1) "Evidently, therefore, the single threads at the earlier stage were chromosomes still undivided although in the earliest visible stage in mitosis they have already divided" (p. 710).

(2) "These observations point to the chiasmata being the immediate cause of pairing between chromosomes" (p. 710).

(3) "The prophase of meiosis therefore starts too soon, relative to the splitting of the chromosomes" (p. 711).

(4) "The decisive difference would therefore appear to be in the singleness of the early prophase threads in meiosis" (p. 711).

Hedayetullah[3] in a very careful and detailed study of the somatic chromosomes of *Narcissus* found that the chromosome consists of two chromonemata each of which splits at metaphase into the two chromonemata of the newly constituted chromosome. The chromosomes at anaphase and metaphase of mitosis thus show as double structures (pairs of chromonemata).

In a paper read on August 22 before Section M of the Australian and New Zealand Association for the Advancement of Science,[4] I pointed out that the double structure of the anaphase and telophase mitotic chromosomes is not consistent with the single structure of the early prophase meiotic chromosomes; and that the resolution of this inconsistency requires a study of the last premeiotic mitosis (a study about to be taken up in *Acacia Baileyana* where that mitosis can be identified with certainty). In the issue of NATURE received in Australia this week, there is the report of an answer to this question by Huskins[1], who finds that the metaphase split of the chromonemata does not occur in the last premeiotic mitosis.

While Huskins' work appears to resolve the difficulty outlined above, it raises further very far-reaching and important questions. Now, in most ovules and some anthers the last premeiotic division results in the formation of primary parietal and primary sporogenous cells. If in this division the chromosomes emerge not split, then the conditions for meiosis must occur in both primary parietal and primary sporogenous cells of many plants. Darlington[2] (p. 711) says: "If we consider that there is a universal attraction of threads in pairs at the prophase of any nuclear division, as we see it at mitosis, it follows that this condition is fulfilled by the pairing of chromosome threads when they are still single", also quotations (3) and (4) above. Why, then, does not meiosis occur also in the primary parietal cells of those plants the primary sporogenous cells of which function as mother cells? Such a question (*mutatis mutandis*) becomes still more acute when the archesporial cell functions as a mother cell.

I am undertaking work on the cytology of *Acacia Baileyana* to seek some contribution to the solution of these problems.

It is worth noting that the larger microsporangia which are more easily handled for plant cytological study would not have a morphology that calls up the questions just brought forward. Moreover, it is notorious how little cytological work is done on megasporogenesis where such questions would inevitably arise. Perhaps one might close with a plea for a closer association of cytology with the study of morphological development.

IVOR VICKERY NEWMAN.
Department of Botany,
University of Sydney.
Sept. 15.

[1] C. L. Huskins, NATURE, **130**, 156, July 30, 1932.
[2] C. D. Darlington, NATURE, **127**, 709, May 9, 1931.
[3] S. Hedayetullah, *J. Roy. Mic. Soc.*, (3), **51**, 347; 1931.
[4] I. V. Newman, Report Sydney Meeting Aust. N.Z., Ass. Adv. Science, 1932 (in press).

Motions of Bodies of Oil on the Surface of Alcohol-Water Solutions

THE reaction was first observed when preparing a solution of spirit and water in which to suspend a body of oil as a sphere. The density of the solution was too great, and the oil rose to the surface as a thick lens-shaped drop. In this state, it was observed that the drop always moved away from an observer, and, on investigation, this was found to be due to the heat of the observer's body.

The effect was used to illustrate surface tension, but, after numerous repetitions, it was noted that the drop always tended to return to a unique position on the surface of the solution very soon after the disturbing cause was removed, for example, by the observer vacating the room for a few minutes.

To test this fact, the flask was shaken and replaced. This did not modify the tendency of the drop to return to its place on the liquid surface; this place was then named, for convenience, the rest-position; it was found to be invariable, in any given position of the flask in the room, so long as the heat field of the room remained tolerably constant.

Further tests of this phenomenon were made by placing the flask on a turn-table and rotating it; in all cases it was found that the drop returned to its rest-position as soon as the solution ceased to rotate.

Reactions were found to take place in flasks and beakers of glass, china, and metal, but they appeared to be modified by the substance of the vessel. All reactions are modified by plane or curved surfaces of glass, metal, paper, etc., placed outside a vessel like reflectors; they modify the motion from a warm body, and they modify the path of return to the rest-position, according to the angle at which such reflectors are set.

There is reason to believe that a magnetic field modifies reactions; it is still in doubt whether a moving magnetic field produces motion in an oil drop.

Light radiation has been found to cause displacement of a drop under conditions which prevented a heated body from producing any reaction. The question remains open whether some portion of light energy had been converted into heat.

Energy given out by an electrified body causes motion of a drop.

It seems probable that those who are interested, and who have facilities for strictly eliminating given forces, will find that all forms of radiation are effective in causing displacement of a drop.

Experiments have been made and repeated numerous times with flasks in lines and in groups. The motions of drops in flasks in groups are suggestive of speculations which it would be premature to present seriously.

All the work has been done with alcohol-water solutions. The reason was that other solutions were tried, but observations were embarrassed by secondary phenomena which could be excluded only by using a fairly constant liquid solution.

It may be mentioned that some experiments were made with an oil drop suspended between a water surface and a petrol surface; the results were quite indefinite, but they seemed to indicate a possibly interesting line of investigation.

The proportions of alcohol to water respectively 1:4 give satisfactory results with the oils named; exact density is not important, but homogeneity of solution is essential. A liquid surface about 10 cm. in diameter with an oil drop about 15 mm. diameter is convenient for observation.

The working hypothesis has been that a liquid surface is, in effect, a neutral gravitational plane where abnormal displacements may be caused by infinitesimal forces.

Glemham, C. T. JACOB.
Harpenden Rd.,
St. Albans.
Oct. 28.

I THINK probably no unusual forces are involved in the motions of oil drops floating on water-alcohol solutions described by Mr. Jacob. A liquid surface, unless of enormous extent, is not a plane; the influence of the curvature at the walls extends several centimetres to the interior of the surface. It is probable that the curvature of a liquid surface in a vessel ten centimetres diameter, or even larger, would be sufficient to cause a floating drop to seek the central position, that is the lowest, by simple gravitational forces; it would move downhill. The curvature in the central part of such a surface would be so small, that very minute forces would suffice to displace the drop from a strictly central position. In the presence of minute, but permanent convection currents caused by differences of temperature in the different parts of the vessel, the position of rest might be some distance from the centre, the natural tendency of the drop to move to the lowest point being balanced by a steady convection current. It is possible that the effect of the electric field in moving the drops is due to a charge on the surface of the drop; but the equilibrium is so easily disturbed that it seems possible that all the phenomena may be due to convection currents, balanced against a minute gravitational restoring force.

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Abnormal Winds in Cordoba

FOR some months past—since about June to the best of my recollection—we have had an abnormal amount of wind from the east and south-east. In fact it could be said that such were and are still the *prevailing* winds.

Ordinarily the winds in Cordoba are from two opposite directions—north to north-east, warm, dry winds, accompanied by clear skies which usually occur the greater part of the time; and cold, strong winds from the south to south-west which follow the passing of a 'low' to the north, for a few hours or a day, seldom longer, often cloudy and with rain. The nights on the pampa are with few exceptions calm. The few exceptions are when a 'low' is passing and not always then. At altitudes above 1,500 metres there are usually high winds at night.

West winds are practically unknown and winds from the eastern quadrant almost as rare, in normal times. For those reasons the large amount of east and south-east winds during the past winter is outstanding and undoubtedly significant.

What is the cause of these deflections? It appears to be suggestive that they are of the kind that might be expected if influenced by the volcanic eruptions in the Andes. The centre of these eruptions is in a latitude slightly south of Cordoba, so that the south-east winds would be blowing counter-clockwise about that region of eruption as about a cyclonic area—a high temperature 'low'.

These south-east winds observed here are *surface* winds, of course, and I have no means of knowing whether the winds in other regions conform to such a possibility or not, or whether the winds at higher altitudes have been affected also.

These east to south-east winds have been accompanied by unusual cloudiness and humidity, and just recently by heavy precipitation in the region to the east, traversed by these winds from the Atlantic, inundating thousands of hectares and destroying the crops. Whether or not the volcanic eruptions have anything to do with the abnormal direction of these winds will require a study of extensive data. If such is not the cause there is some other. From time to time news comes of outbursts from the volcanoes in the Descabezada region. I do not know if they are in continuous eruption, but from the presence of volcanic ash in the air almost continuously during the winter, it seems probable that such has been the case.

The object of this note is to direct attention to a matter which appears to be worth investigating.

C. D. PERRINE.
Cordoba.
Oct. 18.

The Hon. Mrs. Huia Onslow

IT has been decided to prepare a memoir of the late Hon. Mrs. Huia Onslow, better known to the scientific world as Muriel Wheldale Onslow, whose obituary notice appeared in NATURE of June 11, 1932. I shall be very grateful if those who have letters in their possession written to them by Mrs. Onslow would kindly lend them to me for this purpose. They should be addressed to me and will be carefully preserved and returned to their owners.

FLORENCE M. DURHAM.
Hawkern, Otterton,
Nr. Budleigh Salterton.

Research Items

Stone Implements of Choukoutien.—More abundant archæological material and further field work have made desirable a new and supplementary exposition of the facts relating to the stone industry of the Peking man deposits by P. Teilhard de Chardin and Dr. W. C. Pei (*Bull. Geol. Soc. China*, 11, No. 4). The sediments of the Choukoutien Locality 1 (*Sinanthropus* cave) are a massive hard breccia in which at least three cultural zones can be distinguished. The entire deposit of Zone *A* is of red, yellow and black banded sandy clay in which *Aa*, by a dense accumulation of quartz chips and burnt bones, is strikingly similar to the classical culture layers of the western European caves. Zone *B*, remarkably interesting stratigraphically, has yielded but a small series of flaked boulders (choppers). Zone *C*, with the implements of which this communication deals chiefly, is especially significant as the artefacts were discovered in association with *Sinanthropus* remains. Zone *C* has exactly the same lithological character as Zone *A*. The fauna collected in association with ashes and stone artefacts is abundant and characteristic (*Equus sanmeniensis*, *Rhinoceros 'sinensis'*, *R.* cf. *tichorhinus* (?), *Elephas nomadicus*, etc.) Outside the three zones, artefacts are found from place to place and more may be forthcoming. In Zone *C* several thousands of minor fragments of stone have been found and more than a hundred chipped or intact foreign boulders. The stone is green sandstone, commonly, but also vein quartz and, exceptionally, quartzite or quartz-porphyric rock. Provisionally the specimens are classified as flaked boulders, truncated boulders, choppers, quartz cores, scrapers, pointed implements, and chipped or flaked limestone pieces, possibly anvils or hammer stones. The provisional opinion is expressed that the industry of Zone *C* moderately, but distinctly, exceeds what would be expected to be the most primitive recognisable human industry. The makers already had some definite methods of choosing, breaking and adapting stone to several uses; but in so doing they obeyed, rather than mastered, their material.

Prehistoric Cults in Portugal.—The connexion between Christian shrines and prehistoric sites which has been shown to be highly probable in the instance of Saint James of Compostela in Spain, is demonstrated to be equally probable in Portugal by the Rev. E. O. James in a communication which appears in *Folk-Lore*, vol. 43, No. 3. At Mattosinhos, a few miles from Oporto, is the church of Bom Jesus de Boucas, said to be the oldest shrine in the country, which is visited annually by 30,000 pilgrims. The present church was built in the sixteenth century to house a miracle-working cross, alleged to have been carved by Nicodemus, which floated to Portugal from Joppa under divine guidance. It landed at Leixões, a well-known harbour and refuge for vessels avoiding the treacherous bar of the Douro. Although there is no evidence of megalithic monuments in the neighbourhood of Leixões, a pile of rough stones, now surmounted by a tower, stands behind the chapel which marks the landing-place of the cross, and the whole tradition of Mattosinhos points to a legend of the Santiago type. The country to which the Douro gives access is a wide productive belt full of mines, especially of tin and gold, which were worked by the Romans, and presumably long before their day, while there is evidence of important ancient settlements in the province of Minho. The hermitage of São Romão was founded on the site of a ruined Romano-Celtic town. To this hill pilgrimages have been made annually on August 9. Braga, the seat of the primate of Portugal, is the Roman Bracara Augusta. Near it is the sanctuary of Bom Jesus do Monte, visited by thousands at Whitsuntide, and beyond it is another holy hill, the shrine to the Virgin of Sameiro. On the way up to the latter is a small dolmen, revealed in making a motor road.

Psychological Effects of Noise.—The effect of noise on the human mind and body is a problem of much practical importance. Does noise diminish efficiency and increase liability to accidents? Is there any evidence that it plays a part in the development of nervous and mental disorders? Two recent investigations, one in a laboratory and the other in a workshop, seem to indicate that noise is not a negligible factor in determining industrial efficiency ("Psychological Experiments on the Effects of Noise", by K. G. Pollock and F. C. Bartlett. "The Effects of Noise on the Performance of Weavers", by H. C. Weston and S. Adams. Industrial Health Research Board. Report No. 65. London: H.M. Stationery Office, 1932). Pollock and Bartlett, studying the psychological effect of noise on a simple motor skill and upon mental work in a laboratory, found a diminution of efficiency at first but this initial effect appeared to be only temporary. Weston and Adams carried out their investigation in a Lancashire weaving shed and used ear protectors on the workers to reduce noise. The effect was an increase of about one per cent in the average hourly output. The authors find evidence which suggests that even after years of work in a noisy environment the worker does not become completely adapted to noise. As is inevitable in any preliminary work, these two studies open up at least as many problems as they claim to solve, but taken together they indicate that noise may under certain conditions exercise a disturbing effect upon human efficiency, though to a less degree than is commonly supposed.

Phases of Locusts in South Africa.—Under the foregoing title Prof. J. C. Faure of the University of Pretoria contributes an important paper, of general scientific interest, occupying part 3 of vol. 23 of the *Bulletin of Entomological Research* (September, 1932: pp. 293–405, plates 14–38 and one map). Prof. Faure discusses the main theory of locust phases, due to Uvarov, and proceeds to detail the results of an extensive series of experiments designed to test the theory in so far as South African locusts are concerned. Most of his work was undertaken with the brown locust, *Locustana pardalina*, a species of prime importance in South Africa. His results show that 97 per cent of hoppers in the gregarious phase was obtained in the F_1 generation from adults in the solitary phase taken in the field, by rearing the progeny in a dense crowd. Other experiments showed that locusts in the solitary phase, if collected early enough in their development as hoppers and crowded in cages, acquire the coloration of the gregarious phase before reaching maturity. Owing to the fact that no swarms exhibiting the extreme characteristics of the

gregarious phase occurred in South Africa while the work was in progress, it was not possible to investigate similarly the transformation in the opposite direction, that is, from the gregarious phase to the solitary one. Recourse was consequently made to material in the gregarious phase obtained in cage experiments and to hoppers showing gregarious characters obtained from eggs laid by caught individuals in the transient or intermediate phase. By isolating individuals singly in cages, Prof. Faure was able to show that transformation from the gregarious phase to the solitary phase actually took place under these conditions. Detailed examination of the coloration and of biometric data indicated that actual phases, comparable with those occurring in the field, were obtained. The same conclusions were arrived at with regard to experiments conducted with the subspecies *migratoroides* of *Locusta migratoria*. The effects of environment on colour forms, the influence of heredity on phase production and other experiments are also recorded in this paper. The most important results achieved are shown in the experimental production of one locust phase from another, thus confirming in a significant manner the general truth of the phase theory.

Transmission of Light through Air and Water.—Quantitative measurement of solar radiation, never easy, is not made easier when the passage of light through sea or lake water has to be studied on board ship. Dr. W. R. G. Atkins, in "Solar Radiation and its Transmission through Air and Water" (*J. Conseil International pour l'Exploration de la Mer*, 7, pp. 171–211, 1932) has summarised his own work with Dr. H. H. Poole, as well as that of other workers on both sides of the Atlantic. He proceeds from the examination of light as it reaches the earth by means of colour filters and photoelectric cells to the penetration of light through water. For this purpose recent workers have favoured the pyrlimnometer (effectively a thermopile) and the photoelectric cell. Atkins has found the vacuum cell more reliable than the gas-filled. The photoelectric current may be measured either potentiometrically or by means of the neon lamp. The apparatus assembled for the United States research ship, *Atlantis*, is illustrated.

Thermophilic Amœbæ.—Dr. L. G. M. Baas Becking, Botanical Institute of Leyden, Holland, reports the presence of cysts of an unclassified amœba in waters collected from the hot geysers of Yellowstone Park, U.S.A. These cysts began to germinate on the hot stage at 50°–52° C., and withstood a temperature of a little above 60° C., for an hour. The thermophilic characters of this organism, therefore, approximate to those of the amœbæ recorded by Dr. E. Hindle from the thermal springs at Dax, near Bordeaux (see NATURE, 130, 780, Nov. 19, 1932). It is probable that the examination of material from similar sources would reveal the existence of many other examples of micro-organisms living at high temperatures, in addition to the well-known thermophilic bacteria.

Frost Protection for Plants.—The practical gardener has to wage continual war with frost in the late spring and early autumn, even in Great Britain, but the problem is more acute in the United States. Many types of protector have found their way on to the market, and the relative merits of some of these, together with a physiological study of frost protectors in general, form the subject of Technical Bulletin No. 124 of the Agriculture Experiment Station of the Michigan State College ("The Various Effects of Frost Protectors on Tomato Plants" by R. P. Hibbard, pp. 1–36, 1932). The protectors were in the form of more or less conical caps made from transparent paper or cellulose preparations. In one year of the six during which they were under test they were of definite benefit in preventing frost damage to young tomato plants, in two years of doubtful benefit and in three years none at all. They caused a diminution in intensity of light which was often detrimental, though protected plants were usually larger than unprotected plants. The author believes that the raising of twice as many seedlings as are really wanted is a surer and more economical insurance against damage by frost, since half can be planted early and the other half used to replace them if necessary.

Origin of Leucitites and Related Rocks.—A detailed account of the petrology of the volcanic fields near Ruwenzori has been prepared by Prof. A. Holmes, with chemical analyses by Dr. H. F. Harwood (*Quart. Jour. Geol. Soc.*, pp. 370–442; 1932). The associated rocks include olivine-leucitite, leucitite, potash-ankaratrite, melilite-basalt, and biotite-pyroxenite. It is pointed out that the limestone assimilation hypothesis of Daly and Shand provides no way of ensuring an excess of potash over soda such as characterises the province under discussion. Moreover, no limestones are present either in the rocks exposed at the surface or among the ejected blocks, which provide samples of the underlying crust to a considerable depth. The absence of granitic and basaltic rocks, of related types, and of felspars, suggests that any hypothesis invoking granitic or basaltic origin is untenable for this particular province. The rocks have marked geochemical peculiarities which relate them to kimberlite, the rock of the diamond pipes of South and Central Africa, and this suggests a magmatic ancestry in which peridotite magma plays the parental part. It is thought probable that the magmas of kimberlite and olivine-leucitite may be generated by the abstraction of the constituents of eclogite and dunite from a primary peridotite magma under conditions of high pressure, and that the magmas of melilite-basalt and alnoite may be generated under conditions of somewhat lower pressure by the early crystallisation of enstatite as well as olivine. Evidence of the separated crystalline phases is traced in the eclogite and dunite nodules of the diamond pipes and in the enstatite phenocrysts of the melilite-basalt tuffs of Uganda.

Radium in Hungarian Rocks.—The radium contents of some Hungarian igneous rocks have been determined by S. S. de Finály, using the method of Mache and Bamberger. The results for sixteen rocks, together with new chemical analyses of each, have now been published (*Amer. J. Sci.*, Oct., p. 306). Ten granites gave amounts ranging from $1 \cdot 43$ to $3 \cdot 69 \times 10^{-12}$ gm. of radium per gram of rock, the average being $2 \cdot 50 \times 10^{-12}$. The latter is close to the European average so far determined, but is higher than that for the otherwise similar rocks of eastern North America. In four andesites the radium ranges from $1 \cdot 64$ to $2 \cdot 38 \times 10^{-12}$, and averages $1 \cdot 96 \times 10^{-12}$. In two 'basalts', which seem to be wrongly named in view of the chemical analyses, the radium contents are respectively $1 \cdot 48$ and $1 \cdot 93 \times 10^{-12}$.

A High-Voltage Generator.—The *Physical Review* for October 15 contains an interesting suggestion for a high-voltage generator. It is known that large frictional charges are produced by blowing dust-laden air against a conductor. Experiments show that a charge of 6×10^{-6} coulombs can be produced by blowing 1 gm. of diatomaceous earth, and it is suggested that a machine could be constructed to generate 1 milliampere at potentials of the order of one million volts. An experimental apparatus was constructed in which 1·5 gm. per second of diatomaceous earth was blown through insulating tubes and then through metal tubes arranged diametrically in a spherical corona shield. A voltage of 260 kilovolts was obtained and a current of 8×10^{-5} amperes could be drawn from the sphere at this voltage.

Collisions of Neutrons with Electrons and Atomic Nuclei.—Dr. H. S. W. Massey has discussed (*Proc. Roy. Soc.*, Nov.) the collisions of neutrons with electrons and atomic nuclei. The model of the neutron used is a hydrogen atom in a nearly zero quantum state—this model is not admitted by ordinary quantum mechanics, but a non-relativistic theory is certainly inapplicable to these conditions. The collision relations are worked out by the method of Born, Faxén and Holtsmark. The introduction of the value of the collision cross section with lead nuclei (presumably obtained from absorption experiments) allows an estimation of an upper limit for the radius of the neutron of $2·0 \times 10^{-18}$ cm. It is then found that the collision areas with light nuclei vary with the square of the nuclear charge—a much larger variation than is consistent with experiment. The author concludes that the collisions are determined by an internal nuclear field, the penetration being very close. In the case of protons the experiments also appear to require the interaction to be controlled by a powerful intra-proton field. The collisions of the model neutron with electrons are shown to be negligibly probable.

The Hydrogen Isotope, H^2.—In the *Physical Review* for October 1, K. T. Bainbridge describes measurements of the atomic mass of the hydrogen isotope H^2. The measurements are important as a clue to the structure of the H^2 nucleus, since the packing fraction and binding energy of the nucleus may be calculated from them. Ordinary hydrogen and hydrogen fractionated by Brickwedde were successively used in a discharge tube mass-spectrograph. With the enriched hydrogen an ion $H^1_1H^{2+}$ was observed and its position was compared on a microphotometer record with that of He^+. The mass found was 2·01351 ± 0·00018 ($O^{16} = 16$), and if the nucleus consists of two protons and an electron, the energy of binding is 2×10^6 volts. If the nucleus consists of a proton and a neutron of mass 1·0067, the binding energy is $9·7 \times 10^6$ volts. Dr. Bainbridge brings forward considerations to show that H^2 is not a very likely unit in the building up of heavier nuclei. In the *Physical Review* for October 15, Hardy, Barker and Dennison examine the infra-red absorption spectrum of hydrogen chloride. In some of the experiments, the gas was an enriched specimen prepared from electrolytic cell residues. The spectra showed band-lines corresponding to H^2Cl^{35} and H^2Cl^{37}; and calculations show that H^2Cl was present to the extent of about 1/35,000 in ordinary hydrogen chloride and about ten times as much in enriched specimens. On the assumption that the molecular fields were identical for H^1Cl and H^2Cl, the atomic mass of H^2 was found to be 2·01367 ±0·0001, in satisfactory agreement with Bainbridge's value.

Astronomical Topics

Standard Times throughout the World.—A useful brochure, with this title, published by the U.S. Bureau of Standards, contains maps and tables which give the differences between the times used at various stations and those of Greenwich and Washington. The maps bring out the fact that the boundaries of the successive hourly time zones are far from conforming with the theoretical meridians; in fact they are made to conform with the boundaries of States or countries. One might expect that the 180° meridian where the day changes, which is nearly all water, would be straight; but even this shows notable deflections. These irregularities emphasise the utility of such a publication as the present one; without it one might frequently make errors of an hour.

Spectrum of Epsilon Aurigæ.—An exhaustive study of the spectrum of this remarkable eclipsing variable star by E. B. Frost, O. Struve and C. T. Elvey has been published (Pub. Yerkes Observatory, vol. 7, pt. 2). It is chiefly based on spectrograms obtained at Yerkes in the years 1899–1901 and 1917–1931, but results obtained elsewhere have also been utilised. The curve of radial velocities from all sources shows a prolonged minimum about 1910 and another about 1930; the only maximum during the period discussed was about 1925; the extreme velocities are about −13 and +20 km./sec. The light-curve shows that an eclipse began in April 1928; the light declined steadily for six months, then remained constant for a year at 4·2 mag., then returned in six months to the normal value 3·4 mag. Asymmetry in the spectral lines begins about 200 days before the eclipse begins, and continues after it ends; the explanation given is that the eclipsing star has a very extensive atmosphere, the depth of which is determined from the measured velocities to be more than an astronomical unit; the light from the primary suffers absorption in this atmosphere. Other peculiarities in the spectral lines suggest that the secondary star has rapid rotation, producing an atmosphere flattened at the poles and extended at the equator. Its atmosphere is also concluded to be free from magnesium, as this is the only strong line in the spectrum of the primary that is not strengthened during eclipse.

The article also refers to Zeta Aurigæ, which has many points in common with Epsilon; but in its case the spectrum of the eclipsing star (of type *K*5) remains visible throughout the period.

Correction to "Astronomical Notes for December".—The times of occultations of stars by the moon given in NATURE for Nov. 26, p. 817, were those for Edinburgh; the times for London are: ι Aquarii, Dec. 3, 6^h27^m P.M.; μ Arietis, Dec. 9, 11^h8^m P.M.; ρ Leonis, Dec. 19, 0^h24^m A.M.; reappearance 1^h29^m A.M., angle 316°.

Prehistoric Sites near Flagstaff, Arizona*

SOME interesting inferences as to the geographical and economic factors involved in the development and distribution of prehistoric Pueblo culture in parts of northern Arizona are drawn by Dr. Harold S. Colton in a report on a survey of prehistoric sites in the neighbourhood of Flagstaff, which was carried out on behalf of the Museum of Northern Arizona in the course of ten summers between the years 1916 and 1930. It is the intention of the Museum ultimately to survey all sites in the northern area of the State, taking Flagstaff as a centre, but, for the present, attention is confined to those sites which lie to the east, between Flagstaff and the Hopi villages on the edge of the Painted Desert.

The area under investigation culminates in the San Francisco volcanic field, which is the second largest in the United States, and supports two hundred extinct cones, of which the highest form the massif known as San Francisco Peaks (12,700 ft.). From here the land slopes down into the valley of the Little Colorado River, rising again in terraces of vari-coloured cliffs, on the last of which stand the Hopi villages, to the Painted Desert.

The geological structure of the area is seen to have been an important factor in determining the distribution of prehistoric culture. Beneath the fields of volcanic ash and sand lie the Moencopi red sandstones and shales, the only rocks over a wide area which hold water. Wherever they have not been denuded, springs are found. Beneath them lie Kaibab limestone and Conconino limestone, both of which are waterless.

A further factor, which was discovered in 1930 only, is the recent activity of Sunset Crater in early Pueblo times. This was clearly a dominant event in the history and culture of the Pueblos. It took place somewhere between A.D. 600 and A.D. 850. A cover of black basaltic sand was then spread over the land for a radius of about twenty miles, in places near the crater to a depth of as much as two feet. It acted as a mulch, retaining the moisture and affecting the flow of the streams. It was eminently suited to the digging-stick type of cultivation affected by the Pueblo peoples. The population, which had hitherto congregated near the peaks, where a water supply was assured, is seen to have now spread densely over the area covered by the volcanic sand. They withdrew once more to the earlier sites near the peaks, or the shelter of the escarpment, when the prevailing winds in the course of time had removed the sand, except where anchored by vegetation, and had deposited it in the canyons, whence much of it has been carried away by the waters of the Little Colorado.

* "A Survey of Prehistoric Sites in the Region of Flagstaff, Arizona." By Harold S. Colton. Bulletin 104, Bureau of American Ethnology, 1932.

The operations of the survey with which Dr. Colton deals in the present publication recorded 728 sites situated in the drainage areas of two tributaries of the Little Colorado, Walnut Creek and Deadman's Wash. The intervening watershed is omitted for future consideration.

Four culture horizons were recognised, which, in accordance with the nomenclature now adopted in Puebloan archæology, are classed as Basketmaker III, Pueblo I, Pueblo II and Pueblo III. The tree-ring chronology worked out by Prof. Douglass on the basis of the growth of the trees used in Pueblo architecture, gives *circa* A.D. 900 for a few Pueblo II sites; for Pueblo III, *circa* A.D. 1050–1300; and for Pueblo IV, A.D. 1300–1600. Applying this scheme to sites in the Flagstaff area gives the following as approximate dating for certain sites: Wupatki, 1087–1197; Citadel, 1192; Turkey Hills, 1203–1278; Ruin J, 1192. Pueblo IV and V are not represented. It was in late Pueblo II and early Pueblo III that the improvement in the conditions of agriculture and irrigation afforded by the black volcanic sand fostered the spread of a dense population over a wider area. The sites of these periods are thickly distributed between the Peaks and the Little Colorado. Black basaltic sand first enters into the tempering of material used in pottery in middle Pueblo II.

It is also to be noted that in Pueblo II and Pueblo III the pottery complexes in the Walnut Creek drainage and Deadman's Wash differ markedly and point to a complete dissociation of the two areas in culture. For this entire separation of the two tribes no reason is at present apparent.

No less than eight characteristic types of the Pueblo dwelling have been recorded in the area. They range through all stages from pit-houses to the Puebloan masonry multicellular dwelling. Some of the most interesting and characteristic dwellings are the cliff-shelters of Walnut Creek, south-east of Flagstaff, where the Kaibab limestone, overlying a precipitous wall of Conconino sandstone, weathers characteristically in a series of steps forming ledges with overhanging roofs. Here on each tier, rooms have been built in single rows, though in one or two places outer rooms have been added. Several of the dwellings have seven and eleven rooms; one is estimated doubtfully at thirty rooms. The greater number of these sites belong to Pueblo II and early Pueblo III.

A beginning has been made in the further exploration of the whole area by excavation.

The Locust Problem

THE fourth report of the Committee on Locust Control of the Economic Advisory Council* contains a survey of investigations carried out in 1931, and a programme of work for 1932–33. Since the presentation of the previous report of the Committee, in 1930, invasions by the desert locust (*Schistocera gregaria* Forsk.) have continued in almost all the countries in Africa and western Asia that were previously affected. Further, a new and even more serious menace to agriculture in tropical Africa has presented itself in the appearance of great swarms of two other species of locusts, namely, the tropical migratory locust (*Locusta migratorioides* R. and F.) and the red locust (*Nomadacris septemfasciata* Serv.).

* Economic Advisory Council: Committee on Locust Control. Fourth Report: Survey of Locust Investigations in 1931 and Programme of Work for 1932–33. (Cmd. 4124.) Pp. 43. (London: H.M. Stationery Office, 1932.) 1s. net.

Information gathered from official sources shows that the damage caused by locusts during the present outbreak (the period 1927–31) can be estimated, in round numbers, as exceeding £6,000,000, while about £1,000,000 has been spent on control measures. The whole course of this outbreak clearly indicates how close is the dependence of the locust situation in any one territory on the general incidence of the pest over wide areas. This interdependence shows that it is almost futile to control locusts in a few isolated districts. There is an urgent need for concentrating on investigations into the original breeding grounds of each locust species. The discovery of such areas would open up the possibility of each species being dealt with under relatively localised conditions before it is able to spread and become diffused.

The events of the past two years all emphasise the urgency of discovering the specific factors that result in locust invasions in order that a far-reaching policy for the prevention, or at least the reduction of future outbreaks, may be devised. The Committee has drawn up a comprehensive programme of work that it recommends to be carried out in 1932–33 and undertaken through the Imperial Institute of Entomology. At the headquarters of the Institute it is advised that the collection, study and analysis of available information on the problems involved should be continued and extended. The work also includes the task of transferring all records, both old and new, of locust migrations and breeding to maps covering defined periods. Such maps should prove invaluable for tracing the courses of all known invasions and in serving as the basis for studies connected with them. Furthermore, as the Institute is acting as the recognised international clearing house for all information dealing with anti-locust investigation, in this way it is in a position to assist all countries directly affected by invasions. The collection of specimens from swarms appearing in different lands, and at diverse times, is also being undertaken and their availability at the Institute will provide essential material for biometrical and other studies of the phase problem.

The field campaign, drawn up by the Committee, covers the investigation of the life-cycles of the locust species already mentioned; studies of their swarming and transitional phases; the correlation of locust activities with meteorological data and the testing of control measures. These aspects of the work will continue under the direction of the Chief Locust Investigator, Mr H. B. Johnston.

The co-operation of the governments of all countries affected by locust invasions is a matter of prime importance. It is now recognised that investigations of the character planned require to be international if the basic problems concerned are to be fully solved. The Committee acknowledges the value of the co-operation already afforded by the French and Italian Governments, and by the administrations of British colonies and territories, but is anxious to develop mutual effort and the pooling of information on a much wider scale. Recommendations are consequently made that the Economic Advisory Council should invite the Secretary of State for Foreign Affairs to communicate copies of the present report with an expression of hope of co-operation, in the work now planned, of governments that were not represented at the Rome conference on locust control in 1931.

In the matter of finance, the recommendations of the Committee are on a very modest scale considering the importance of the schemes involved. The 1932–33 programme, as estimated, can be carried out at a cost of £3,800, of which £395 represents capital expenditure on tents, apparatus, etc., and £3,405 is recurrent expenditure mainly for salaries, wages and travelling charges. It is to be hoped that the campaign now taking shape will be allowed to develop so fully as possible, in view of the magnitude of the losses sustained through locust invasions in so many areas of the British Empire and indeed throughout the world.

A. D. IMMS.

The Rubber Industry of Malaya

A SERIES of memoranda with an introduction by Dr. H. A. Tempany which have recently been issued in Malaya deal with the position of the Rubber Research Institute of Malaya and indicate that four distinct proposals for the future are before the Board. The retrenchment memorandum put forward by the executive committee estimates 350,000 dollars as the sum on which the Institute's activities can be maintained. This involves a reduction in expenditure of 183,000 dollars and at a special meeting of the Board of the Institute held on June 28, the recommendations of the executive committee were adopted with minor modifications.

The proposal of the Hon. B. J. R. Barton that the whole of the work of the Institute should be amalgamated with the Department of Agriculture was prompted by the belief that, while the retrenchment proposals did not go far enough to bring relief to subscribers in any appreciable reduction in payment of cess, they would accentuate a feeling of discontent among the staff of the Institute and that the organisation would not represent the best possible in the interests of the Industry. Mr. Barton stressed the advantages of the Department of Agriculture and while the retrenchment proposals may involve curtailing the advisory work, the activities of the Institute can scarcely be maintained at more than a semblance of their present efficiency. The representatives of the Malaya Estate Owners Association urged that the situation should be investigated by an independent body, but this proposal was also negatived.

The proposals adopted by the Board, after accepting the view that 350,000 dollars represents the minimum upon which the activities of the Institute can be effectively maintained and the maximum which can be at present expected from the export cess levied on rubber, since the area of untapped rubber which escapes all contributions is expected to increase, provide for retrenchment by reduction in salaries, in the personnel and on allowances for cess, etc., on duty. In addition to a reduction of 5 per cent already imposed, a further reduction of 20 per cent on all salaries is now contemplated. With regard to personnel, the research services are graded in the order of importance, chemical, botanical, pathological, soils, field; and restriction of activity by reduction of personnel is advocated to fall with increasing incidence in the descending order shown above. On account of the increasing importance of latex, it is recommended that reduction in the chemical and pathological divisions where research on latex

is principally carried out should be a minimum.

The heads of divisions presented alternative proposals which also were not accepted. These proposals were backed by a strong plea that they were the outcome of careful thought by those who had exceptional opportunities of studying the working of the Institute and the needs of the industry. They recommend a complete reorganisation of the personnel and work of the Institute on two main lines: (i) work on the product—chemical; (ii) work on the tree—botanical, including agricultural and both research and advisory work. They envisage four senior scientific officers and one administrative officer working as an executive cabinet under a director, preferably someone quite free from outside affiliations and selected mainly for administrative ability and experience. Such a scheme, if staffed with officers capable of working in absolute harmony, should develop the team spirit essential to success. A selection and a list of temporary salaries were included with these proposals.

In view of the growing recognition of the importance of Imperial research on Empire products, it is disappointing to learn of this serious threat to rubber research and the uneasiness with which scientific workers and others regard the situation will not be diminished by the Board's dismissal of the alternative scheme and proposals put forward by the scientific and technical heads of divisions. The reductions in salary and personnel adopted by the Board appear likely to have an untoward effect on the recruitment for Imperial services abroad generally. In view of the comparatively early age of retirement in such services and the difficulty frequently experienced in securing an appointment on return to Great Britain, such drastic reductions in salaries will deter many promising scientific officers of high ability from coming forward for service abroad.

Ultra-short Wave Technique in Radio Communication

AT the International Congress of Electricity held in Paris in July last, some twenty-six papers were read before Section 9 dealing with various aspects of radio engineering, ranging from commercial telephonic communication to the study of the electrical properties of the upper atmosphere. Among these papers, two are of particular interest in connexion with the progress of ultra-short wave technique.

The first of these, by I. E. Mouromtseff and H. V. Noble, describes a new type of ultra-short wave oscillator. This consists of a special three electrode valve in which the cylindrical anode and spiral grid form part of a concentric transmission line, which itself replaces the tuned circuit normally associated with an oscillating triode. For cylindrical conductors the diameters of which are of constant ratio, the inductance and capacity of the line will satisfy the condition of uniformity of distribution, and when the necessary supply voltages are connected to the electrodes at suitable points oscillations will be set up on the line at a wave-length equal to twice the length of the line. These oscillations take the form of stationary waves giving rise to no external field or radiation, but a suitable open or closed circuit may be coupled to the line, in order to make use of the high frequency power. A large water-cooled transmitting valve constructed on this principle has been made to generate up to 16 kilowatts at wave-lengths of 3 and 5 metres, with an efficiency of from 20 to 40 per cent.

The use of this principle would appear to overcome some of the difficulties of making high-power valves for short wave-lengths, which arise from the necessity of reducing inter-electrode capacity in valve oscillators using one of the ordinary circuit arrangements. Since the reading of the paper in Paris, a more complete account of this work has been published in the *Proceedings of the Institute of Radio Engineers* for August 1932.

In the second paper, I. E. Mouromtseff and G. R. Kilgore give a description of some experiments on a magneto-static oscillator for the production of oscillations at wave-lengths of 50 cm. or less. The special valves employed are similar to the magnetron type, comprising a cylindrical anode, split longitudinally into two parts, and containing a straight axial filament. This valve is placed in a suitable coil supplying a constant magnetic field in the direction of the axis. The two halves of the anode are connected to two parallel wires forming a Lecher wire system which can be adjusted to resonate at the desired wave-length. Yagi and Okabe had previously remarked that, in the ordinary magnetron, when the conditions were such that the electrons passed very close to the anode without touching it, weak oscillations of a very high frequency were to be observed.

The present researches show that the intensity of these oscillations can be enormously increased if the direction of the magnetic field is altered by a small angle from the axis of the valve electrodes. Graphs accompanying the paper referred to above, show that the oscillations attain a maximum intensity for angles between 2° and 10°, depending upon the dimensions and operating conditions of the valve. Examples are quoted in the paper of valves capable of producing oscillations of appreciable intensity at wave-lengths of 22–55 cm. R. L. S.-R.

University and Educational Intelligence

BIRMINGHAM.—The Executive Board of the Birmingham Hospitals Centre, of which Sir Charles Grant Robertson is chairman, has decided to proceed immediately with the provision of the new hospital at Edgbaston on the site of 100 acres adjoining the University given by Messrs. Cadbury Brothers. The first instalment is to consist of 500 beds. This scheme (which has been suspended for many months in consequence of the national financial stringency) is of vital importance to the University, the Medical School of which is to be housed in buildings forming part of the hospitals centre. It has been disclosed that a contribution of £52,000, hitherto anonymous, was made by Sir William Morris (of Morris Motors Ltd.) on the understanding that the work should be begun by January 1, 1933. A donation of £100,000 was made by Mr. Harry Vincent, treasurer of the fund, and another contribution, by an anonymous donor, of £50,000 has been received. The total cost of buildings and equipment is estimated at above £718,000, of which more than £647,000 has already been contributed or promised.

CAMBRIDGE.—The General Board has recommended that vertebrate zoology be added to the list of sub-departments in the Department of Zoology, with the reader in vertebrate zoology as director of the sub-

department. It has also recommended that a readership in vertebrate zoology be established and that Mr. C. Forster Cooper, of Trinity Hall, be appointed to the readership as from October 1, 1932.

EDINBURGH.—A legacy of £1,300 by the late Prof. Baldwin Brown has been received to establish a "Baldwin Brown Travelling Scholarship in Fine Art" for the benefit of women students in the subject of fine art. It is to be used for the study of archæology, painting and sculpture and the decorative arts among the buildings and collections of England, France, Belgium and Holland.

WALES.—The Council of the Welsh National School of Medicine has appointed Dr. J. B. Duguid as professor of pathology and bacteriology, and Dr. G. I. Strachan as professor of gynæcology.

THE quarterly record of current educational publications issued by the Office of Education, Washington, is, in its recently improved form, an invaluable instrument for enabling teachers in the United States (where about a million persons are, it is said, engaged in educational work) to keep abreast of the literature of their vocation. It includes a classified and annotated list of significant publications selected by specialists in each of the following fields: nursery-kindergarten-primary, elementary, secondary, exceptional children, educational psychology, junior colleges, education of teachers, universities, public school administration, adult education, vocational education and guidance, negro education and foreign education. In addition there are useful itemised lists of proceedings and annotated lists of reports of associations, and, of course, lists of the publications of the Office of Education itself. The space devoted to the subjects falling within the headings "Exceptional Children" and "Psychology" is remarkable. It includes the following among other sub-headings: behaviour and problem cases, gifted children, guidance, heredity, individual differences, learning, measurement, mental tests, personality and character.

THE *Universities Review* for October contains a further contribution to the discussion, begun a year ago, of "What is Wrong with the Modern Universities?" The writer, Mr. P. Mansell Jones, of Cardiff, suggests that "it is our working idea of a university which is wrong". The schemes of study and methods of work lack the elasticity indispensable for meeting the differing needs of individual students, and degree requirements necessitate the pursuit of numerous short courses administered in water-tight compartments. Hence the (alleged) prevalence among British students of an artificial separation between life and work, resulting in indifference to and sterilisation of the intellectual life. In the same issue of the *Review* is a report of a lecture by Sir Josiah Stamp delivered at Princeton University last April on the contribution of academic life to economic problems of the day. Referring to the impression he had received in America of widespread loss of faith in institutions, men, and 'slogans', Sir Josiah exhorted his hearers not to lose faith in the value of striving for intellectual solutions. Not only should economic problems be subjected to strenuous investigation by scientific methods but there is also an economic hinterland and a moral hinterland to every field of specialised knowledge, and this region should be surveyed with confidence by every outgoing graduate.

Calendar of Geographical Exploration

Dec. 5, 1766.—Bougainville's Circumnavigation

Louis Antoine de Bougainville sailed south for the third time in the *Boudeuse*, charged with the commission of ceding the settlement on the Falkland Islands, which he had organised in 1763–65, to Spain, and continuing his voyage across the Pacific. Bougainville returned in 1769, having accomplished the circumnavigation of the globe, the first Frenchman to achieve this. His voyage is of interest because a botanist and an astronomer were taken for purposes of scientific research, an example soon followed by other expeditions, with great benefit to the cause of science. Bougainville discovered many new islands in the Pacific, including the Navigators' Islands in the Samoan group, the Grand Cyclades of the New Hebrides, and Bougainville and Buku Islands in the Solomon group; the strait between the former island and Choiseul is named after him. The simplicity and humour of his narrative of the journey round the world gained great popularity for it.

Dec. 7, 1872.—Start of the *Challenger* Expedition

H.M.S. *Challenger* sailed from Sheerness on one of the most fruitful scientific expeditions ever organised. The British Admiralty and the Royal Society cooperated in organising the voyage, Sir G. S. Nares undertaking the naval command, and Sir Charles Wyville Thomson taking charge of the scientific side. Two traverses of the North Atlantic Ocean were made, and one of the South, the Wyville Thomson ridge being charted. The Pacific and Antarctic were then visited and the *Challenger* returned in 1876 with scientific data which filled fifty volumes published between 1880 and 1895, under the editorship of Sir C. Wyville Thomson and Sir John Murray. Many little-known places were charted and surveyed and the longitude of others was corrected. The contours of the great ocean basins were determined, much new information about deep sea temperatures and about ocean currents was obtained, the structure of coral reefs was investigated and many biological surveys were recorded.

Dec. 10, 1607.—John Smith in Virginia

John Smith set out to discover the source of the Chickahominy River. It was on this voyage that Pocahontas, the little daughter of the great Indian chief Powhatan, saved Smith's life by her pleadings. In the spring of the same year, Smith had accompanied Capt. Newport in an exploration of the James River to the falls at Richmond. In 1608 Smith explored Chesapeake Bay and went up the Potomac to the site of the present city of Washington and up the Rappahannock to where Fredericksburg now stands. Smith's maps of Chesapeake Bay and of the New England coast from Penobscot to Cape Cod are remarkably accurate.

Dec. 10, 1883.—The Masai Country

Joseph Thomson reached Victoria Nyanza after successfully crossing the country inhabited by the Masai, whose fierce exploits had barred the way to Uganda. Thomson had been sent out by the Royal Geographical Society to examine the possibility of taking a caravan through their country. Leaving Mombasa he crossed the Njiri Desert, explored the rift valley and discovered Lake Baringo. In 1878 the same Society had sent an expedition to East Central Africa and when its leader died, Thomson, who was then

but twenty years old, took over the command, crossed the country between Nyasa and Tanganyika and discovered Lake Rukwa. Later, Thomson explored part of the Atlas range. In 1890 he set out from Quilimane and travelled in the regions between Nyasa, Bangweolo and the Zambezi, covering nearly a thousand miles of unexplored country.

Societies and Academies

LONDON

Mineralogical Society, Nov. 1.—**H. H. Read** and **B. E. Dixon**: On stichtite from Cunningsburgh, Shetland. Stichtite is found at the above locality as rose-pink patches, partly replacing chromite in a serpentine rock. Characters determined include $D = 2 \cdot 19$, refractive indices γ 1·559, α 1·543. Probably biaxial. Chemical analysis and discussion of earlier analyses give as the most probable formula $2(Cr, Fe)(OH)_3 . 5Mg(OH)_2 . MgCO_3 . Mg[CO_3 . (OH)_2] . 4H_2O$.—**H. H. Read**: On quartz-kyanite rocks from Unst, Shetland Islands, and their bearing on metamorphic differentiation. Quartz-kyanite rocks occur as vein-like bodies in kyanite-chloritoid-schist, also as blocks scattered over the slopes. They are intimately associated with rocks much poorer in silica and richer in alumina than the normal country rock. The main component of these associated rocks is kyanite, with chlorite, and 'iron ore'. The origin of the rocks and certain general problems connected with metamorphic differentiation are discussed.—**L. J. Spencer**: A new meteoric iron found near Kyancutta, South Australia. A mass of iron weighing 72 lb. was found in June 1932 just below the surface in a sandy paddock, 28 miles east-south-east of Kyancutta. It shows the characters of the common type of medium octahedrites, and is very similar to the numerous masses of iron found around the meteorite craters near Henbury, in Central Australia, 630 miles distant from Kyancutta.—**C. A. Silberrad**: List of Indian meteorites. The places of fall of the 106 meteorites that have been recorded in India since 1795 are located as accurately as now possible, and plotted on a map. Percentages are given for the day and night falls, and of the monthly falls.—**W. Campbell Smith**: Meteoric stones from Suwahib, Arabia. Within 30 miles of Buwah in Suwahib, where Mr. Bertram Thomas found a chondritic meteoric stone in 1931, two other stones were found a year later by Mr. Philby. They closely resemble the Buwah stone and may belong to the same shower. Sixty miles to the south a third stone was found at Umm Tina, near Shanna well. This is a chondrite of Baroti type and differs from the other two, which belong to the Cronstad type.—**Arthur Russell**: An account of British mineral collectors and dealers in the seventeenth, eighteenth and nineteenth centuries (contd.). Sir Charles Lewis Giesecke, born on April 6, 1761, and died on March 5, 1833, was christened Johann Georg Metzler. He wrote the libretto of Mozart's "Magic Flute" (1791) also other operas. In 1794 he began the serious study of mineralogy and travelled extensively. Later he settled in Copenhagen. In 1806 he undertook a mineral collecting trip to Greenland and remained there seven years, amassing a large collection. The specimens collected during the first two years were captured by an English frigate on their way to Denmark, and were brought to Leith, where they were bought by Thomas Allan. On his return from Greenland in 1813 Giesecke landed at Leith and traced his collection to Allan, with whom he became very friendly. In 1814 he was appointed professor of mineralogy to the Royal Dublin Society, which position he held until his death.—**Arthur Russell**: Note on an occurrence of witherite at the Morrison North Pit, Stanley, Co. Durham. Pure, massive witherite fills a fault fissure cutting coal at this pit.—**M. H. Hey** and **F. A. Bannister**: Studies on the zeolites (4). Ashcroftine (kalithomsonite of S. G. Gordon). The pink zeolitic mineral described by S. G. Gordon in 1924 as a potassiferous thomsonite (kalithomsonite) is shown by X-ray and optical data to be an independent species in no way related to thomsonite, and the name 'ashcroftine' is proposed for it. Ashcroftine is tetragonal with cell sides c 17·49, a 34·04A., a unit-cell content about $40[NaK(Ca,Mg,Mn)Al_4Si_5O_{18} . 8H_2O]$, and D 2·61 ± 0·05. The refractive indices (ϵ 1·545, ω 1·536) are much higher than those of artificial potassiferous thomsonites, and the optic orientation is different.—**W. C. A. Guthrie** and **Christina C. Miller**: The determination of rock constituents by semi-micro-methods. The ordinary course of the analysis of an igneous rock can be very considerably expedited by the use of smaller amounts of material throughout, the necessary accuracy of weighing being attained by means of a microbalance. Numerous experiments show that such a procedure is reliable and involves no loss of accuracy.

Royal Meteorological Society, Nov. 16.—**J. Edmund Clark, Ivan D. Margary, Richard Marshall** and **C. J. P. Cave**: The Phenological Report, 1931. 1931 was officially described as 'wet and dull', the emphasis is on the latter; yet it was the tenth successive year with excess of rain, the total being that of eleven average years. A fresh table gives for each of the thirteen districts the number of weeks showing 'decided' and 'excessive' divergence from the average for temperature, rainfall and sunshine. December 1930 and November 1931 were alone much on the warm side; March and September cold. Such short cold spells in spring threw the flower records back half a week and although migrants reached our coasts to date their progress inland was belated. Slugs and weeds, as might be expected, caused exceptional trouble. Thanks to a second broadcast in March 1931 the corps of observers slightly exceeded 600. More would be specially welcome in West Ireland and North Scotland.—**Sir Napier Shaw** and **Comdr. L. G. Garbett**: A new sort of wind rose. In ordinary meteorological practice, for the representation of wind conditions for stations on land or selected areas at sea, figures or roses for the several months are set out on separate sheets. Consequently, anyone who wishes to visualise the sequence within the year has to take note of information on twelve separate pages. Examples are now given of diagrams in which the results for the twelve months of the year are combined without sacrificing the information for the separate months.—**G. S. P. Heywood**: Katabatic winds in a valley. A Dines pressure-tube anemometer was erected in a valley in the Cotswolds, with the vane 15 ft. above the ground. The meteorological station at Leafield was situated 2¼ miles away, and the records of the anemometer of that station were compared with those obtained in the valley. The speed of the katabatic flow was seldom greater than 1 m./sec., when a katabatic flow was taking place, and the temperature records at Leafield showed an inversion on all those occasions. Observations of smoke drift show that katabatic flow may occur in a layer near the ground without influencing the anemometer at 15 feet.

EDINBURGH

Royal Society, Nov. 7.—W. F. Harper: Supernumerary pectoral fins in *Raia circularis*, Loudon. A male sandy ray (length 43 cm.) caught in the North Sea exhibited a very rare abnormality which consisted of two well-developed fins situated ventrally and associated with the pectoral girdle. Each fin measured 8 cm. long. A single bar of cartilage connected with the coracoid by a fibro-elastic band formed the basal support of each fin, and extended two-thirds of its length before articulating with a series of six jointed radialia. The muscular mass of each fin had a double origin from propterygium and coracoid, and was innervated by the third and fourth spinal nerves.—Amy M. Fleming: The innervation of the uterus. In the uterine muscle there is an irregular asymmetrical non-medulated nerve plexus, the fine nerve fibres of which wind round the smooth muscle cells. Three types of nuclei are present on the course of the nerve bundles. There are four types of plexus-forming cells which show a greater affinity for methylene blue than do the surrounding connective tissue cells. In certain of each type of multipolar plexus-forming cells there are granules sometimes joined by very fine fibrils. A connexion can sometimes be traced between a varicose nerve fibre and one of the processes of the nerve cells.—M. H. Fullerton: Development of the olfactory organ in *Protopterus*. The olfactory organ arises as a solid ingrowth of the deep layer of the ectoderm in which the cavity forms by cytolysis. The anterior portion of the originally slit-like opening which becomes the anterior naris lies in the region of definite ectoderm; the posterior portion which becomes the internal narial opening, lies, however, in the region of heavily yolked cells ('endoderm'). *Protopterus* therefore supports the view that the boundary between ectoderm and endoderm is not a sharp line but a broad 'debatable' zone.—S. L. Hora: Development and probable evolution of the suctorial disc in the tadpoles of *Rana afghana*, Günther. A series of developmental stages enables the author to describe the steps in the formation of the ventral suctorial disc in the tadpole of *Rana afghana*. Some of these steps correspond with the final conditions encountered in the tadpoles of other and different species of *Rana*. The whole process is similar to that in the fish *Garra*. It is concluded that the origin and development of the disc of *R. afghana* can be explained as due to a series of small and gradual changes induced by recognisable factors in the environment which necessitated a change of habit on the part of the organism. The change in habit resulted in the modification of the existing structures and in the ultimate production of a powerful sucking disc.—James Brough: Evolution of the catopterid fishes. A detailed description of the hitherto unknown structure of the head of *Dædalichthys* and the description of a new genus *Campylognathus* is given. The structure of all known forms of the Triassic family of catopterid fishes is analysed, and an attempt is made to indicate the directions in which the family evolved. The trends are of two sorts, those characteristic only of this family and a series of major trends which also went on, independently, in other contemporary groups of bony fishes. A consideration of the latter leads on to a discussion of the general principle of parallelism in evolution.—W. H. Lang: Contributions to the study of the Old Red Sandstone flora of Scotland. Part 7. On *Arthrostigma*, *Psilophyton* and some associated plant remains from the Strathmore beds of the Caledonian Old Red Sandstone. Remains of *Arthrostigma gracile*, Dn. and *Psilophyton princeps*, Dn. (including *P. Goldschmidtii*, Halle) from Scottish rocks are described in detail. In the case of *Arthrostigma* the epidermis and stomata, the tracheidal structure of the central vascular strand, and slender trace bundles in the cortex are described. The epidermis, stomata and tracheidal tissue of *Psilophyton* are compared with the corresponding features of *Arthrostigma*. The spines of *Psilophyton* are described in detail. They agree with the spines of the type material from Gaspé. Sporangia and spores associated with the vegetative remains in Scotland also agree with those from Gaspé.

PARIS

Academy of Sciences, Oct. 24 (vol. 195, pp. 685–724).—Paul Delens: The formal operations of the logical calculus.—D. Pompeiu: Theorems of existence for the zeros of holomorph functions.—Maurice Gevrey: Systems of partial differential equations of the parabolic type.—Marcel Brelot: The point singularities of sub-harmonic functions.—Henri Roure: New formulæ for the calculation of special perturbations.—Gustave André Mokrzycki: The longitudinal balancing of aeroplanes.—Emile Sevin: Cosmic radiation. A theory is developed based on the wave conception of the electro-magnetic radiations leading to the expression for the wave-lengths (λ) which can arise, $\lambda = 3 \cdot 95n \times 10^{-13}$, where n represents a series of simple numbers. The results obtained with this formula are compared with those of Millikan and Cameron and those of Sir James Jeans.—R. Wavre: Certain single layer potentials, generators of real and multiform harmonic functions.—L. Goldstein: A new isotopic effect. The theory developed predicts an isotopic effect in Raman spectra, the order of magnitude of which is the same as that observable in the rotation-vibration bands of isotopic molecules.—P. de Fonbrune: An apparatus for manufacturing glass instruments intended for micro-manipulations. The technique described is based on the use of a source of heat, easily regulated, placed under the microscope.—E. Darmois and Mlle. M. Murgier: The influence of molybdates on the rotatory power of xylose. From the study of the variations of the specific rotatory power, evidence of the existence of the compound $NaHMoO_4.2C_5H_{10}O_5$ is obtained. This compound has a much higher optical activity than that of xylose.—A. Travers and Silice: Dilute perchloric acid as an oxidising agent.—Jacques Bourcart: Sediments of the schlier type in Morocco. An attempt at a palæogeographical reconstitution.—J. Malavoy: The Voltaian and Atacoran (Gold Coast, Togo and Dahomey).—H. Lagotala: Preliminary note on the geology of Loutété-Mounié (Gouéris region, in the middle Congo).—L. Clariond: The extension of the ante-Visean movements in Morocco.—Aug. Chevalier and Conrad Kilian: The presence of the Silurian and of a Palæozoic flora between Kaouar and Tibesti (eastern Sahara).—Pierre Lesage: The progressive acquisition of precocity in *Lepidium sativum*. The heredity of the character of precosity in the open air after life under a frame has been preserved for at least eleven generations at Rothamsted, Rennes, Clermont, Valence, Marseilles and Algiers. At Rennes, this precocity has not been appreciably altered in a series of cultures from the first to the eleventh generation. Diagrams are given shewing the curves of growth at Rennes and at Rothamsted from 1929 until

1932.—Ch. Dubois and N. Sollier: The experimental diagnosis of melitococcia in sheep and goats by means of the allergy reaction. An emulsion of *Br. abortus* has proved to be the best antigen for this reaction: by its means sick animals and germ carriers can be detected. All subjects reacting can be considered as dangerous for other animals and for man.

Forthcoming Events

MONDAY, DEC. 5

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Lieut.-Col. C. W. Furlong: "Tierra del Fuego".

UNIVERSITY OF LEEDS, at 5.15.—Dr. E. J. Holmyard: "Chemistry in the Ancient World and the Middle Ages".

WEDNESDAY, DEC. 7

BRITISH INSTITUTE OF RADIOLOGY, at 5—(Thirteenth Mackenzie Davidson Memorial Lecture at the Central Hall, Westminster).—Dr. J. Chadwick: "The Neutron".

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.45.—Discussion on "Protective Adaptations of Animals, especially Insects", to be opened by Prof. E. B. Poulton.

BIRKBECK COLLEGE, at 8.15—(Foundation Oration).—The Right Hon. Lord Macmillan: "The Sense of Values".

THURSDAY, DEC. 8

BRITISH INSTITUTE OF RADIOLOGY, at 5—(Fifteenth Sylvanus Thompson Memorial Lecture at the Central Hall, Westminster).—The Right Hon. The Viscount Lee of Fareham: "Radium as a Therapeutic Agent—The Case for National Control".

ROYAL SOCIETY, at 4.30—(Croonian Lecture).—Prof. Davidson Black: "The Discovery of *Sinanthropus*".

FRIDAY, DEC. 9

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. Davidson Black: "*Sinanthropus*" (second lecture on Dec. 12).

BRITISH INSTITUTE OF RADIOLOGY, at 2.30—(Presidential Address at the Central Hall, Westminster).—Prof. F. L. Hopwood.

ROYAL INSTITUTION, at 9—Prof. J. G. Gray: "Gyroscopic Tops and Combinations".

BRITISH INSTITUTE OF RADIOLOGY, Dec. 7–9. Annual Congress at the Central Hall, Westminster.

Official Publications Received

GREAT BRITAIN AND IRELAND

International Federation of University Women. Bulletin No. 14: Report of the Sixth Conference, Edinburgh, July 27 to August 4, 1932. Pp. 181. (London: Crosby Hall.)

University of Durham. Abstracts of Theses for Doctorates presented by Candidates who have received the Degrees in Convocation during the Academical Year 1931–1932. Pp. 12. (Durham.)

A Study of the Deaf in England and Wales, 1930 to 1932: being a Report by Dr. A. Eichholz to the Minister of Health and the President of the Board of Education. Pp. iv + 206. (London: H.M. Stationery Office.) 3*s*. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 71, No. 431, November. Pp. 685–836 + xviii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

The British Mycological Society Transactions. Edited by J. Ramsbottom, B. F. Barnes and H. Wormald. Vol. 17, Part 3, 11 November. Pp. 157–236. (London: Cambridge University Press.) 7*s*. 6*d*.

Transactions of the Geological Society of Glasgow. Vol. 19, Part 1, 1928–1931 (continued). Pp. iv + 224. (Glasgow.) 7*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1460 (I.C.E. 850): Experiments with a Supercharged Single-Cylinder Unit. By Dr. G. F. Mucklow. Pp. 57 + 42 plates. 3*s*. net. No. 1468 (T.3268): High Speed Induced Wind Tunnel. By A. Bailey and S. A. Wood. Pp. 21 + 15 plates. 1*s*. 3*d*. net. No. 1478 (T.3254): Efficiency of Tail Plane behind Wing of R.A.F. 34 Section. By D. M. Hirst and A. S. Hartshorn. Pp. 4 + 4 plates. 4*d*. net. (London: H.M. Stationery Office.)

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1931–32. Pp. 36. (Aberdeen.)

Philosophical Transactions of the Royal Society of London. Series A, Vol. 231, A694: The Electric Field of Overhead Thunderclouds. By Dr. Sudhansu Kumar Banerji. Pp. 27 + 6 plates. (London: Harrison and Sons, Ltd.)

Department of Scientific and Industrial Research. Report of Further Tests by the Director of Fuel Research on the Turner Retort installed at the Works of the Comac Oil Co., Ltd., Coalburn, Lanarkshire: Tests carried out 13th November to 3rd December, 1930. Pp. viii + 35. (London: H.M. Stationery Office.) 9*d*. net.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (New Series), No. 10, October. Abstracts Nos. 1762–1951. Pp. 327–362. (London: H.M. Stationery Office.) 1*s*. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1426 (T.3235): Recovery from a Spin. By L. W. Bryant and Miss I. M. W. Jones. Pp. 24 + 8 plates. 1*s*. 3*d*. net. No. 1474 (T.3161B): The Distribution of Turbulence over the Central Region of a Pipe. By A. Fage and H. C. H. Townend. Pp. 6 + 5 plates. 6*d*. net. No. 1484 (G26.40): Reduction of Fire Risk by Induction Pipe Flame Traps. By Andrew Swan, Squadron Leader W. Helmore and W. C. Clothier. Pp. 16 + 11 plates. 1*s*. net. (London: H.M. Stationery Office.)

OTHER COUNTRIES

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 659-A: A Method of Estimating Ground-Water Supplies based on Discharge by Plants and Evaporation from Soil; Results of Investigations in Escalante Valley, Utah. By Walter N. White. (Contributions to the Hydrology of the United States, 1932.) Pp. v + 105 + 10 plates. Water-Supply Paper 659-B: Geology and Ground-Water Resources of the Dalles Region, Oregon. By Arthur M. Piper. (Contributions to the Hydrology of the United States, 1932.) Pp. iv + 107–189 + plates 11–19. 25 cents. Water-Supply Paper 698: Surface Water Supply of the United States, 1930. Part 3: Ohio River Basin. Pp. viii + 292. 20 cents. Water-Supply Paper 700: Surface Water Supply of the United States, 1930. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. v + 149. 15 cents. Water-Supply Paper 720: Surface Water Supply of the United States, 1931. Part 10: The Great Basin. Pp. v + 99. 10 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the American Academy of Arts and Sciences. Vol. 67, No. 5: Bacterial Detoxification. By Robert S. Harris and John W. M. Bunker. Pp. 147–168. 60 cents. Vol. 67, No. 6: Note on Stellar Perturbations of nearly Parabolic Orbits. By E. Öpik. Pp. 169–184. 45 cents. (Boston, Mass.)

Bulletin of the Madras Government Museum. New Series, General Section, Vol. 1, Part 2: Catalogue of the South Indian Hindu Metal Images in the Madras Government Museum. By Dr. F. H. Gravely and T. N. Ramachandran. Pp. ii + 144 + 23 plates. (Madras: Government Press.) 5.8 rupees.

Index to the Memoirs of the Geological Survey of India, Vols. 1–54. 1859 to 1929. By T. H. D. La Touche. Pp. vii + 431. (Calcutta: Government of India Central Publication Branch.)

Report on the Zoological Survey of India for the Years 1929 to 1932. Pp. iii + lvii. (Calcutta: Government of India Central Publication Branch.) 1 rupee; 1*s*. 9*d*.

Proceedings of the United States National Museum. Vol. 82, Art. 1: A Remarkable New Genus and Species of Two-winged Flies related to the Œstridæ. By Charles H. T. Townsend. (No. 2942.) Pp. 4. (Washington, D.C.: Government Printing Office.)

Conseil Permanent International pour l'Exploration de la Mer. Faune Ichthyologique de l'Atlantique nord. Publiée sous la direction de Prof. Joubin. No. 11. 24 planches. (Copenhague: Andr. Fred. Høst et fils.) 4 kr.

Field Museum of Natural History. Anthropological Series, Vol. 17, No. 4: The Solar Year of the Mayas at Quirigua, Guatemala. By J. Eric Thompson. (Publication 315.) Pp. 365–421. (Chicago.) 35 cents.

Journal of the Indian Institute of Science. Vol. 15A, Part 6: The Equilibrium between Dimethyl Ether, Methyl Alcohol and Water. By N. G. Gajendragad, S. K. Kulkarni Jatkat and H. E. Watson. Pp. 59–70. (Bangalore.) 1 rupee.

U.S. Department of the Interior: Office of Education. Leaflet No. 43: Elementary School Principals, some Data on their Education, Experience and Salaries. By Walter S. Deffenbaugh. Pp. 11. (Washington, D.C.: Government Printing Office.) 5 cents.

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1931. (Publication 3142.) Pp. xiii + 592 + 87 plates. (Washington, D.C.: Government Printing Office.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 30, Part 5: Studies on the Nature of "Koji-Diastase". By Mitsuji Ito. Pp. 243–386. (Tokyo: Maruzen Co., Ltd.)

Japanese Journal of Mathematics. Transactions and Abstracts, Vol. 9, No. 2, October. Pp. 87–160. (Tokyo: National Research Council of Japan.)

Japanese Journal of Astronomy and Geophysics. Transactions and Abstracts, Vol. 10, No. 1. Pp. 79 + 16. (Tokyo: National Research Council of Japan.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 3, Part 6: Tertiary Mollusca from the Coalfield of Uryu, Ishikari. By Matajiro Yokoyama. Pp. 221–247 + 4 plates. (Tokyo: Maruzen Co., Ltd.) 0.70 yen.

Contributions from the Physical Laboratories of Harvard University for the Years 1930 and 1931. Vol. 21. 40 papers. (Cambridge, Mass.)

The University of Colorado Studies. Vol. 19, No. 4. Pp. 399–420. (Boulder, Colo.) 1 dollar.

CATALOGUES

Catalogue of New Book Bargains. (No. 396.) Pp. 16. Book Bargains. (No. 399.) Pp. 6. (Cambridge: W. Heffer and Sons, Ltd.)

A Classified Catalogue of Books, Autographs and Manuscripts. (Catalogue No. 552.) Pp. 124. (London: Francis Edwards, Ltd.)

SATURDAY, DECEMBER 10, 1932

CONTENTS

Editorial and Publishing Offices:
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Research as a Nation's Investment

SOCIAL conventions classify us as workmen, as employers of labour, as professional persons, as people of leisure, or as the 'idle rich'; but there are times when we all seem to be 'in very much the same boat'. In modern politics a man's vote is worth the same as his master's, and we are getting accustomed to the corollary that this implies an equal degree of responsibility in the public regulation of the affairs of both. One of the more important of these affairs is the means of livelihood, and one of the primary duties of the State is to formulate and carry out such policies as will, in a fundamental and broadly conceived way, promote the material prosperity of its citizens.

If world events during the past fourteen years had not already taught us the lesson, those of the immediate past, and indeed of the present, must surely have made abundantly clear how vitally the ordinary individual in a community such as ours depends for his well-being on the industrial condition of the nation. Business men and operatives may be the first to feel the effects of competition and the loss of markets, but sooner or later the 'sheltered' worker, the professional man, and the gentleman of leisure, whether as earners of income or as payers of tax, are caught in the inevitable undercurrent. The first impulse of each is to exert his bodily strength against the tide, and the second to help another to struggle. No doubt the first few men who fell into the sea struggled likewise, until by research and invention means were found to ride instead of sink; so that to-day the sea is a great highway of commerce, and not merely a human grave. All because man was not content only to turn his face towards 'adverse forces', but went to some trouble, and doubtless to some initial expense, to obtain knowledge enough to convert a menace into an advantage.

Whether our pre-history is weak or not, this is what passes through the mind on reading Sir Frank Smith's recent Norman Lockyer lecture of the British Science Guild on "Industrial Research and the Nation's Balance Sheet"*, and on looking for some adequate reflection of its thesis in the debate in Parliament on the Address in reply to the King's Speech. The discourse is an opportune contribution to the nation's discussions, and the

* The British Science Guild. The Norman Lockyer Lecture, 1932: Industrial Research and the Nation's Balance Sheet. By Sir Frank Smith. Pp. 31. (British Science Guild, 6 John Street, London, W.C.2.) 1s.

occasion demands that prominence should be given to hard facts and authoritative opinions concerning the relation which subsists between the organised prosecution of research and the industrial future of Great Britain. In one or other of its aspects the matter has frequently been examined in the columns of NATURE; nevertheless, so vital is its importance, and so convinced are we that the exigencies of the moment are more likely to obscure than to clarify political vision, that we must return to it again and again without apology, and with all the earnestness at our command.

Four references appear to have been made during the debate following the King's Speech to the part which science must play in solving our industrial problems; we could have wished for a wider appreciation of the real position. Mr. Davies said that the fundamental cause of our depression is the failure to re-adapt our lives to the swift-moving changes brought about by science, which is a partial truth, but not a very helpful pronouncement. The Marquess of Dufferin and Ava expressed the hope that the Government would help in every way scientific research, so that the country might be given a start comparable with that which it had in the nineteenth century; perhaps an assumption that such a policy may be taken for granted may explain the noticeable absence of any echo in the Upper House. The Prime Minister, Mr. Batey, and the noble Marquess referred specifically to the hydrogenation of coal, a process which, if commercially successful, would infuse new life into the coal-mining industry and reduce or arrest the importation of petrol.

Sir Frank Smith's discourse contains statements of fact which show generally, and in this specific instance particularly, how profitable such research is. Five or six years ago, the cost of producing petrol from coal by hydrogenation was estimated to be not less than 2*s*. 6*d*. a gallon, whereas to-day it is 9*d*.; what it will be five years hence will depend on many factors, not the least of which is the progress of research. The main product is not just some sort of oil, but a No. 1 grade petrol. Now, petrol to the value of £13,690,000 was imported in 1931, and Sir Frank Smith states that this year the same quantity of petrol may cost us £26,000,000. In the consideration of figures and opportunities such as these, the cost of the research itself is surely of small moment. Nor are results and prospects far different in other directions of industrial research. Millions of workers are now employed in the new industries based directly on scientific research—artificial silk, wireless, the generation and use of electric power, motor transport, and the cinema; recent investigations into the storage of apples—of which we import nearly eight million pounds worth a year—are believed to have led to an increase in the growers' returns by £100,000. One reads here of a former loss of £250,000 in a year which has been reduced to negligible proportions; there of a loss of fifty million pounds a year which awaits its turn for attention.

Every day in 1931 Great Britain imported on the average more than a million pounds worth of food; how much that we paid for was wasted by deterioration before it could be consumed? If home produce is included, and if (as has been stated) such loss approaches twenty per cent, is not the prize worth an enormously intensified national effort? Research means more than the invention of some ingenious mechanical device which captures the imagination, or alleviates an unwelcome personal exertion; it is not served by romancing Press 'stories' in which a slender basis of fact is made the theme of a sensational announcement. Whether its achievements intrigue the public, or whether they can be appreciated only by technicians, the simple fact is that scientific research has proved itself to be one of the pillars of modern competitive industry. What the ordinary citizen so often fails to realise is the part which fundamental scientific research (exemplified by that performed at the universities) and applied technical research (exemplified by that performed by the industries themselves and by such agencies as the Department of Scientific and Industrial Research) is *already* playing in maintaining him with some degree of stability and comfort in that state of life which he has reached. Nor does he properly appreciate the crash—industrial, political, and social—which would necessarily follow the neglect of opportunities to acquire new knowledge of material resources and new power to use them.

It is the business of scientific men and women to explain to others the position as they know it and the future as they see it. To-day it is more necessary than ever that they should strive to show the voter that research is not merely the concern of the capitalist who uses it to safeguard his possessions; not only the concern of the employer whom it helps to use services and materials to the best advantage; not only the servant of the worker, the conditions of whose

labour have, in many cases, been improved out of all recognition; but also the benefactor of the poor, into whose homes it brings much that was formerly reserved for the rich; and the chief hope of the unemployed, whose chance of a job depends so much on the development of new industries. Where industry and research are concerned, we are indeed all 'in very much the same boat'. The bigger and the better we can make that boat, the happier and the safer we shall be.

The Legality of Sterilisation

EARLY this year a Departmental Committee was appointed by the Minister of Health to examine and report upon the information already available regarding the hereditary transmission and other causes of mental disorder and deficiency, to consider the value of sterilisation as a preventive measure, having regard to its physical, psychological and social aspects, and to the experience of legislation in other countries permitting it, and to suggest what further inquiries might usefully be undertaken in this connexion. This Committee, which is still sitting, is not concerned with the translation into action of any recommendation that it may make, but there is in being a small non-party group, the secretary of which is Wing-Commander A. W. H. James, already prepared with a permissive Bill to legalise the voluntary sterilisation of certain mental defectives, and which has been waiting for the opportunity of introducing this during private members' time. Recently this Parliamentary Sterilisation Committee has circulated to both Houses a memorandum which explains its views and gives a detailed account of the Bill that it is proposed to introduce.

This Bill must surely commend itself to biologists, physicians and lawyers, for it is well drafted, deals only with the mentally deficient (a group with regard to the desirability of whose procreation no doubt has ever been expressed by anyone) and it is a sound project in racial improvement. Many will perhaps deplore the fact that this Bill restricts itself to the mentally deficient, and is meant to apply only to England and Wales. It is greatly to be hoped that it will become law, for the present dubiety concerning the legality of sterilisation cannot possibly be allowed to continue. It would seem that the legality of sterilisation of a normal adult is doubtful. Certainly, a number of sane persons are being sterilised voluntarily, considering this the most efficient method of contraception, and being convinced that they should not run the risk of producing a second abnormal child; none of those, so far, has been prosecuted. There is little doubt, however, that it is unlawful to sterilise a defective, yet this is being done, but only in the case of the well-to-do. It is because sterilisation might be regarded as being illegal that it remains, for the time being, a luxury for the rich, since State, municipal and charitable institutions dare not do it.

So it is that the well-to-do, through voluntary sterilisation, are preventing the repetition of hereditary blunders, whilst the poor, who outnumber them, cannot imitate them, even though they would. For this reason, if for no others, it is highly desirable that this Bill, a purely permissive Bill, concerned solely with voluntary sterilisation, shall become a law of the land.

The Scientific Spirit in Education

Education and the Social Order. By Bertrand Russell. Pp. 254. (London: George Allen and Unwin, Ltd., 1932.) 7*s*. 6*d*. net.

THIS brilliant and provocative essay on the relation of the individualistic and the civic or social aspects of education is in the true lineage of Thomas Huxley and Prof. H. E. Armstrong and deals out essentially the same trenchant criticism of our crooked thinking and stupid prejudices in this field, above all on the place of science in education that we associate with these pioneers and their followers. Mr. Bertrand Russell's philosophic temper makes the book a contribution to the theory and practice of education which even his opponents ignore at their peril, and his able analysis of the social aspects of the educational problem, no less than his fair but searching criticisms of many of the weaknesses in our present system, should commend the book to all scientific workers who are concerned with the place of science in the modern State.

Like every other thinker of this age, Mr. Russell sees that the future of civilisation depends on co-operation, not merely nationally but also internationally, and he considers that the most vital need of the near future is the cultivation of a vivid sense of citizenship of the world. He recognises that under the transforming hand of science the world has become one economic unit, although the backwardness of our political institutions and

beliefs lead each nation to impoverish itself by economic isolation demanding competition when co-operation of the human race as a whole is the price to be paid for the resources and productive powers conferred by science. Until the world has become secure as a single economic and political unit, our whole civilisation is in jeopardy and thus the establishment of an international authority sufficiently strong to impose its settlement of disputes upon recalcitrant States is a reform as fundamental from an educational as from other points of view.

The formidable obstacles to such reforms can only be overcome as a result of education: "The cure for our problems is to make men sane and to make men sane they must be educated sanely." Obviously Mr. Russell leans to individualism, but the philosophic outlook leads him reluctantly to concede that politically in relation to the needs of the civic the education of the citizen must take precedence of that of the individual. Doubtless even the philosopher in him finds some satisfaction for this concession in the paradox that while governmental power depends finally on science, the scientific spirit or the frame of mind which facilitates discovery is one which favours change and certainly not *a priori* the beliefs or opinions which the State considers it prudent for the good citizen to hold. Whether or not the conflict thus suggested between the scientific spirit and the governmental use of science is likely to bring scientific progress to a standstill, there are obviously real dangers in the situations which may arise unless a scientific spirit or a willingness to experiment, not usually characteristic of administrators, finds its way into the seat of power in the modern State. The repression of scientific thought, like the repression of individuality, may have powerful and unexpected repercussions; and Mr. Russell's picture of a society in which the educational system has imposed excessive uniformity, governed in consequence by those whose suavity enables them to please the crowd, is less fantastic than might at first appear.

Having conceded the importance of education for citizenship at the present time, Mr. Russell has felt himself at liberty to indulge in his powers of wit and irony; and he has not dealt too gently with the numerous prejudices and superstitions which encumber education to-day and hinder its fundamental task of fitting the individual for life. Such questions as education and heredity, emotion and discipline, the influence of the home versus the influence of school, the place of the herd instinct, sex, patriotism and class feeling in education, he touches shrewdly and does not shrink from pressing home his argument to uncomfortable conclusions. Once again we are reminded that unless the virulence of nationalism can be abated civilisation cannot continue, or that for those contemplating the entry of a profession, the latter part of their education should be spent in acquiring such knowledge as would enable them to pursue their profession with intelligence and breadth of outlook. On the subject of competition he has trenchant remarks to make not merely on the evils of the examination system but also on the related problem of over-education. "Our social structure increasingly depends upon *trained and well-informed intelligence*." "The average citizen cannot play his part in a complicated world unless he is more accustomed than at present to view practical issues as matters to be decided by the application of trained intelligence to masses of fact, rather than by prejudice, emotion and clap trap." How far we are as yet from this position every newspaper reveals daily; and much of the interest with which the communistic experiments in Russia are followed is due to the fact that they represent the trial of an educational system in which the anti-social element of competition has been eliminated.

Education, however, is not governed wholly by utilitarian conditions or, as Mr. Russell points out, the place of science would be much larger. Economic factors bulk large and have varying effects—incidentally, they do not provide the obstacle to raising the school age in England and Mr. Russell's hit at sectarianism goes fairly home, equally with his criticism of the dead hand of endowment. One of the most valuable chapters in the book is that which analyses the dangers attending the growing tendency to propaganda in education. Failure to teach the young to reach correct conclusions wherever possible not only promotes faction and the danger of destructive conflict but also gravely impedes scientific progress as well as retards the development of that invaluable asset in practical life—the ability to reach true conclusions on insufficient data, dependent on the scientific absence of bias and power of hypothetical thought but also on that quality called judgment which even our universities seem largely unable to impart.

Into this attempt to reconcile individuality and citizenship in education, Mr. Russell weaves a good

deal of his own philosophy of conduct. He gives us indeed no detailed programme though he clearly looks to the growth of the experimental spirit, notably in administration, for the toleration of individuality in the scientific State, and this can only come as education becomes more scientific. This reads strangely like General Smuts's plea for the scientific expert in public affairs, and the whole book might equally be regarded as an exposition of that statesman's warning of the dangerous gap between scientific advance and stationary ethical development—a plea for sincere and courageous thinking and an honest endeavour to order our lives and the lives of the community in harmony with modern knowledge and resources.

R. BRIGHTMAN.

British Freshwater Copepods

British Fresh-Water Copepoda. By Dr. Robert Gurney. Vol. 1. (Ray Society Vol. 118 for the Year 1931.) Pp. lii + 238. Vol. 2. (Ray Society Vol. 119 for the Year 1932.) Pp. ix + 336. (London: Dulau and Co., Ltd., 1932.) 25*s.* each volume.

DR. ROBERT GURNEY'S monograph has been eagerly awaited by all copepod workers. It comes at a peculiarly propitious time for Brady's book, esteemed as it was for many years, and still useful, is now definitely out of date, and a very large amount has been done on the subject since its publication. It is fitting that this new handbook should also be published by the Ray Society, for here we can always rely on the combination of the best matter with excellent editing and form. The present work is not only up to the usual standard but also is exceptionally good, as we should expect from the author who, among many other things, is an expert in the study of copepods, not only systematic—although his knowledge of their systematics is very extensive—but also their bionomics, which study is becoming increasingly important.

The publication of this work at the present time is propitious from another point of view, because the Freshwater Biological Association has recently been founded and among the many subjects of study the bionomics of the copepods may perhaps be said to be among the first in importance. In other countries much has been done in this line but there is still much to do and this book with its suggestiveness and its beautiful and accurate drawings (original drawings by the author himself) will go far in helping those in Great Britain to take a leading part in such biological studies. To determine the species accurately is of the first importance in any scientific research of this kind, and there is now no excuse for it to be neglected.

The species of freshwater copepods in the British fauna are well known and it is not likely that new species will be discovered, but many workers are interested in finding new, so-called, sub-species and varieties. As Dr. Gurney truly remarks, "what is most needed now is not search for these new forms and the hasty emission of geographical speculations founded upon them, but painstaking study of variability and experimental breeding".

The book embodies much of the author's own work and shows a wide knowledge of the work of others. Vol. 1 begins with a bibliography of forty-three pages. Then follows the general part with a good historical account of work done in Britain and in Europe, economic importance of copepods, their food, habitat and methods of collecting, distribution, distribution in relation to the origin of the freshwater fauna, classification, genera and sub-genera, species and sub-species, distribution of allied species, external structure and metamorphosis.

The systematic part, occupying about two-thirds of the book, includes the four families of the Calanoida—Centropagidæ, Diaptomidæ, Temoridæ and Acartiidæ. Each species is carefully described and figured with details of all important structures, and, what is peculiarly satisfactory, the development, in most cases worked out by the author. In thus embracing the development in a large number of species the monograph is unique.

The distribution of each species both in Britain and abroad is given in great detail. In a few instances marine species which enter rivers or estuaries are included, such as the coastal species *Centropages hamatus* which is common in estuaries, and *Acartia clausi*, the latter having a distinct estuarine form, physiologically and structurally distinct.

Vol. 2 deals entirely with the Harpacticoida, the most difficult and exacting group of all the Copepoda. Although many workers have occupied themselves with it there still remains much to be done and the systematic part is in a very unsettled state. Dr. Gurney has done much to clear things up and in spite of some opposition wisely remains

faithful to his own interpretations. Unlike the Calanoida, in which many of the life-histories are complete, the Harpacticoida are little known and until the publication of this volume in no case had the sequence of the copepodid stages been fully worked out. Differences in the nauplian stages are very small and in the copepodid stages measurements are unreliable owing to the contractility of the body. The general characters of the Harpacticid nauplius are given in the first volume. In the second the nauplii of *Canthocamptus pygmæus* are described as typical and the copepodid stages of *Canthocamptus staphylinus*, which are precisely comparable to those of a calanoid. The nauplii of other species are described and figured whenever possible.

The distribution of the Harpacticoida offers many interesting problems and there is much work to be done in clearing these up. The author's discussions under the head of bionomics of the separate species are very valuable and in some cases at least tend to repudiate the idea of any influence due to the glacial period.

The descriptions of the separate species as found in Great Britain are full and clear, involving much laborious counting and figuring of spines and setæ, the figures as before being models of what such illustrations should be.

Marine as well as freshwater copepod workers will be greatly helped by this important work and will look forward to the third volume.

The Science of Colloids

Kapillarchemie: eine Darstellung der Chemie der Kolloide und verwandter Gebiete. Von Prof. Dr. Herbert Freundlich. Band 2. Vierte unter Mitwirkung von J. Bikerman umgearbeitete Auflage. Pp. xi + 955. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932.) 69 gold marks.

PROGRESS in science, like corrosion, is apt to travel along interfaces, and few areas recently brought under the plough of adventurous workers have yielded a richer harvest than the territory between chemistry and physics occupied by the science of colloids. All the tools available in both the classical branches of knowledge are necessary for the exploitation of this field, yet it requires also its own distinctive outlook and skill. The growth of standard works in a new subject such as this is naturally slow, for each worker tends to review the field from a point of view dependent on his special explorations, and in consequence many of the earlier books were partial in their account of the work done and it was difficult to obtain from them a clear and balanced view of the whole subject.

Prof. Freundlich's "Kapillarchemie" has always been largely free from this defect, and with almost uncanny foresight he adopted in the first edition in 1909 the classification which has served for each succeeding edition. The first volume of the present edition, published two years ago, contains the introductory matter on which the subsequent development of the theme depends, and this second volume will appeal more to the colloid chemist who is interested in the practical side of the subject. In it the typical colloid systems—sols and gels—are systematically discussed, and it is very significant that a much larger proportion of generalised statement is now possible, at least for sols, than could be made a few years ago; so that only one-sixth of the total space devoted to lyophobe sols is now required for individual properties, whereas formerly it was necessary to deal with almost every sol singly. The gels and to some extent the lyophile sols are too distinctive in many properties for general treatment.

One of the most interesting recent developments in the study of colloids is the application of X-ray analysis to the constituent particles of sols and to such gels as rubber and cellulose and their derivatives. The research which has been carried out in these directions is ably summarised and illustrated. The same may be said of other modern work; it is, indeed, very satisfactory to find even some of the more obscure memoirs discussed systematically and in proportion.

While the output of work along the main lines continues in ever-increasing volume, there is evidence that some of the less obvious though not less important systems are being studied. Sols and gels in non-aqueous media, in which ionic effects are absent or profoundly modified, smokes, fogs, foams and colloid systems in solid media, all deserve further attention, if only because of their industrial importance. The meagre information available is indicated in this work.

It is perhaps superfluous to add that in style and completeness, this new edition of "Freundlich" easily maintains its place as the foremost textbook of colloid chemistry.

P. C. L. THORNE.

Short Reviews

Chemical Engineering and Thermodynamics applied to the Cement Rotary Kiln. By Dr. Geoffrey Martin. Pp. xv + 244. (London: Crosby Lockwood and Son, 1932.) 31*s*.

THE cement industry, at a time of great prosperity, celebrated the centenary of the discovery of Portland cement by Aspin by abandoning its research association and allowing the scientific staff to dissipate! Whatever the causes that led to this action, it can only be regarded with regret. Every industry sheltered by a tariff or existing as a monopoly has a national obligation from which it cannot escape. The country has a right to buy cement of the highest quality at the lowest price, equal in every way to that available throughout the world, and it is doubtful whether, under modern conditions, fundamental advances can be achieved without the daily aid of applied science.

Amongst the practical problems of the industry those connected with the rotatory kiln stand foremost. Its fuel efficiency is to-day stated to be but 19·2 per cent, the radiation losses 15 per cent. Dr. Martin has prepared what amounts to a research treatise in which he reduces to a matter of exact thermodynamical calculation most of the quantities connected with the rotatory kiln, and sets out data which should enable engineers to design a really efficient kiln.

The book is essentially one for experts, and the mass of data required will need a good deal of sifting and analysis before use, but it is set out so that the task should not be beyond the capacity of any designing engineer, to whom the work will be indispensable. It is of interest that in the clinkering zone only the heat above a temperature of 1481° F. is of value, so that there is an enormous loss when this high grade heat passes up the kiln to the preheating and evaporating zone.

In a final chapter the author describes recent efforts to design kilns of greater thermal efficiency, particularly some methods of preventing these internal radiation losses: he also deals with the flotation kiln which is under experiment at Asheham. The work is a definite contribution to the detailed study of an important subject though it is certainly very difficult to read.

An Introduction to the Theory of Canonical Matrices. By Prof. H. W. Turnbull and Dr. A. C. Aitken. Pp. xiii + 192. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1932.) 17*s*. 6*d*. net.

A SIGN of the present-day tendency of mathematical thought is in the changed character of many of the books now produced. In the last few years almost all new books in pure mathematics have represented one of two main branches—geometry and analysis. Just now, works on algebra are being published in greater profusion, not the old type of algebra reminiscent of such authors as Salmon and Weber, but a newer type in which the fundamental laws of ordinary algebra are not necessarily valid.

A matrix can be defined most simply as the transformation from one tetrahedron of reference (in n dimensions) to another and, when there are three tetrahedra, the transformation from A to B can be compounded with that from B to C into a single transformation from A to C. Quite recently Heisenberg and Dirac have shown that matrices are eminently suited to the purpose of stating and developing the laws of the new quantum mechanics. The authors of the book before us have collected together, with very full references, all the more important investigations on matrices, and now present them as a co-ordinated whole. A central problem is the reduction of a homogeneous quadratic function of n variables to the form

$$a_1x_1^2 + a_2x_2^2 + \quad . \quad . \quad . \quad . \quad . \quad + a_nx_n^2$$

This is possible in $\frac{1}{2}n(n-1)$ ways and, when all the symbols are real, the number of positive a's is the same for each.

Although the book is mainly a compilation, Chap. ix contains a new investigation of the canonical reduction of a pencil of matrices when the determinant of every member of the pencil is zero. Some applications of matrices to projective geometry are given, and others to differential equations and dynamical oscillations. The book is practically self-contained and is intelligible to a reader with ordinary mathematical knowledge.

Hunger and Work in a Savage Tribe: a Functional Study of Nutrition among the Southern Bantu. By Dr. Audrey I. Richards. Pp. xvi + 238. (London: George Routledge and Sons, Ltd., 1932.) 10*s*. 6*d*. net.

DR. RICHARDS' study of the satisfaction of hunger as an element in the organisation of human society has a twofold interest. It is, as Prof. B. Malinowski says in a highly laudatory preface, the first systematic study of the subject in anthropological literature; and it is an originally conceived and at the same time instructive example of the application of the conception of 'function' to the study of the part played by certain biological needs of man in knitting together and determining the form and relations of economic and social units in a given society. Incidentally, it affords the author an opportunity of arguing cogently and pointedly against the predominance of sex in human affairs as interpreted by the psycho-analysts on the ground of the greater insistency of the needs of the human organism in the matter of food—needs which cannot be repressed indefinitely or even for any great length of time.

Dr. Richards, after stating her case in relation to the points of view of psychology and biology, and pointing out the inadequacy of the commonly accepted economic and sociological methods of approach, proceeds to show how among the south-eastern Bantu food—its acquisition, preparation, preservation and distribution—is fundamental, functionally, in determining the organisation and

working of the social, economic and religious systems, imposing on each social group and its individual members an appropriate ritual and code of behaviour. The whole conception has been worked out by the author systematically to its logical conclusions; and lest it should be thought that Dr. Richards has merely added another to 'arm-chair' studies based upon the observations of others, it must be mentioned that she has tested her material thoroughly in the field during over a year's residence among the Bamba.

Petroleum in the United States and Possessions. By Ralph Arnold and William J. Kemnitzer. Pp. xxi + 1052. (New York and London: Harper and Bros., 1931.) 63*s.* net.

THIS volume constitutes the second of a series of four books destined to cover the entire field of petroleum technology, the others being devoted to principles, occurrences external to the United States, and economics. The incentive to this achievement is "the desire to learn the facts of petroleum and the industry . . . without personal prejudice, biassed influence, or preconceived ideas". The task was a gigantic one, as the authors soon found, and if this volume is a foretaste of the others to come (the reviewer is not aware of their appearance in Great Britain yet), then it is truly a *magnum opus.* Even so, it is unwieldy, not so much on account of its bulk of more than a thousand closely printed pages, but of bulk of data.

The plan is to deal with petroleum in productive areas first, giving summarised statements of geology, development, technology and statistics of every field; so to non-productive areas (States) and extra-American possessions. Elaboration, particularly of statistical detail, is overwhelming; one wonders what purpose it all serves. In fact, in so far as this volume is indicative, we are unable to find anything strikingly new or outstanding from the wealth of technical and economic literature already available. If it is a case of geology of petroleum in America, not only is there more than one good modern textbook available, but also the publications of the U.S. Geological Survey and the American Association, to mention only two prolific sources, are easily accessible. If it is statistics or technology, we turn at once to at least half a dozen specialised volumes, and, of course, to the Bureau of Mines. Thus, while one can only marvel at the patience and enormity of labour represented by this particular book, from the point of view of a valued, permanent contribution to science, our reception of it is but lukewarm.

Aristotle. By G. R. G. Mure. (Leaders of Philosophy Series.) Pp. xi + 282. (London: Ernest Benn, Ltd., 1932.) 12*s.* 6*d.* net.

IT is a little more than a year since the admirable translation of the whole corpus of Aristotelian writings was completed under the editorship of Prof. J. A. Smith and Mr. W. D. Ross. It was amazing to think that it had never been done before, but very satisfactory that it was so well done at last. Then we have the full and useful book of Mr. Ross on "Aristotle" and another by Mr. J. L. Stocks on "Aristotelianism". Now Mr. Mure publishes a book which to a large extent combines the merits of both these, and is a model of skilful compression and arrangement. It is not quite easy reading, though very well written, but can be recommended to anyone who, knowing something of philosophy and interested in its general development, desires to see Aristotle's work surveyed as a whole and placed in its true position, in regard both to his predecessors and the subsequent trend of western thought.

Mr. Mure is a Jaegerite in the main, as every one must be, in tracing Aristotle's work back to Plato's, from which it springs, partly by suggestion, partly by criticism. But he treats the particular textual analysis of Jaeger with the caution that any such work demands in detail. The net result is a most enlightening study from which two main conclusions stand out. One, the most obvious, is that we must in future treat the conjunction Plato-Aristotle rather by way of complement than of opposition; the other, the most surprising, that, with his supreme and encyclopædic mind, Aristotle should have made so little of the mathematics which were flourishing in an advanced state around him. "Aristotle and Mathematics" should be the next monograph on the subject; it is the least fully treated in Mr. Mure's volume.

F. S. M.

Respiration in Plants. By Prof. Walter Stiles and Dr. William Leach. (Methuen's Monographs on Biological Subjects.) Pp. vii + 124. (London: Methuen and Co., Ltd., 1932.) 3*s.* 6*d.* net.

IN spite of the importance of respiration as a fundamental property of living protoplasm, there has been for a long time no really general and up-to-date treatment of the subject from the point of view of the botanist and of the non-specialist reader. The present authors have treated the subject particularly from this point of view. They have attempted to indicate the principles underlying modern studies of plant respiration rather than to present a complete summary of recent researches.

While no doubt opinions may differ as to whether the authors have chosen the best examples to illustrate the arguments, there can be no question that on the whole they have succeeded in their object of providing a readable and understandable treatment of a complex subject. They first discuss the respiration of plants in air; secondly, anærobic respiration; and thirdly, the mechanism of respiration. The third of these chapters is naturally the one offering the greatest opportunity of development. It reaches its highest levels, perhaps, in dealing with the bearing of sugar structure on the availability of hexoses, in discussing the rôle of cytochrome and in summarising Blackman's scheme for the respiration of apples.

Atomic Physics and Vital Activities*

By Sir F. GOWLAND HOPKINS, P.R.S.

THE success of the two discussions held during the current year has justified the policy which decided that such discussions should be organised from time to time. In particular they are valuable when they tempt distinguished workers from abroad to visit the Society as contributors to debate. In the discussion on the structure of atomic nuclei opened by Lord Rutherford, the revelation of new experimental results and of their great significance gave a dramatic character to the meeting. The atomic nucleus for a long time had seemed to be an impregnable fortress; but missiles of high destructive power have been gradually contrived by almost magical skill in the army of attack, and the fortress, in spite of its formidable potential barrier, is crumbling.

It is interesting for the spectator to realise how much is learnt by the commanders of the attack from the nature of the missiles (parts of itself) with which the fortress replies to the bombardment. One cannot help recalling the sense of progressive accomplishment which was conveyed in Lord Rutherford's opening address, as for example when he dealt with the nuclear origin of the γ-rays. Nor can one forget moments of actual excitement as when, recalling a twelve years' old prophecy of his own respecting the probable existence of neutrons, he referred to Dr. J. Chadwick's recent success in producing these entities (of which the mass is unity and the charge zero) by bombarding beryllium with α-particles from polonium. Exciting again was the account of the striking results obtained also in the Cavendish Laboratory by J. D. Cockcroft and E. T. S. Walton, who constructed an apparatus capable of providing a steady stream of protons, of energy up to 600,000 volts, and successfully employed the stream in the disintegration of the lithium nucleus.

It is not unjustifiable to say that before the moment of Cockcroft and Walton's success, man did not know how to release atomic energy on his own initiative, whereas now, though doubtless in a limited sense, he possesses that power. At the same time, the phenomenon of transmutation seems to be at hand in full reality. The occasion of this discussion cannot fail to stand out as of much significance in the annals of the Royal Society and in the history of Great Britain's contribution to science.

The second discussion dealt with the growth of knowledge at a different level of present accomplishment; but with phenomena that are very significant. It was concerned with recent studies of the nature and properties of those highly active catalysts—the enzymes—the presence of which in each living unit converts a system, which without them would be static, into an organism which is so characteristically dynamic. Anyone who reads in succession the records of these two discussions as found in our *Proceedings*, will perhaps be tempted to wonder how soon, if ever, intellectual concepts, based upon the phenomena which were the subject of the first, are fated to invade, and perhaps revolutionise thought in the great field of which the second covered part. Will the data of atomic physics ultimately illuminate the processes of life?

At present we know nothing to suggest a certain answer. I have indeed met not a few who had a strong *a priori* conviction that life, in some way, in some limited sense at least, makes use of atomic energy; that such ability might indeed be the special stamp of life. Some twelve years ago a distinguished Dutch physiologist, the late Prof. Zwaademaker, thought he had proved that the weak radioactivity of potassium is an indispensable stimulus to certain vital activities; but the importance of this influence would seem to be at most very small. Even Zwaademaker did not hold that it conditioned life. Its radioactivity is certainly not the main reason for the indispensability of potassium in living systems.

Certain recent experimental studies, however, seem to have proved that living tissues may be the seat of radiations able to produce effects at a distance, and to suggest that certain activities in one cell of a tissue can thus influence activities in neighbouring cells. It was claimed some time ago by Gurvitsch, a Russian biologist, that when growing cells divide they emit rays which accelerate the processes of division in other cells. The existence of these mitogenetic rays, so called because of the claim mentioned, met at first with general disbelief, and a year ago I might have been disinclined to mention the subject; but work by many during the last year seems to have brought satisfactory proof that chemical reactions in living tissues are indeed accompanied by radiations, and events in one cell may thus influence other cells without material transmission.

The phenomena as described are doubtless related to that of chemiluminescence which many non-biological reactions display, and may perhaps have affinities with the emission of more intensive radiations by specialised cells in the luminiferous organs of animals or by luminiferous bacteria. The much more general invisible radiations under reference have been now studied by physical methods. Their emission from active cells has been (it is claimed) demonstrated by means of Geiger's counter; their wave-length measured, and by methods which I must not stop to describe, their specific spectra in various cases duly mapped. It has even been claimed, for example, that a characteristic spectrum of a radiation from a tetanised muscle is identical with that yielded

* From the anniversary address to the Royal Society, delivered on November 30.

in vitro by a reaction (the breakdown of creatin phosphate) known to occur in active muscle.

Many published statements of this kind must be received with hesitation until fully confirmed; but that activities in living cells may be accompanied by radiations recognisable by physical means is now, I think, a fact which is proved. This alone will certainly lead to many fresh lines of inquiry. It is not yet proved, however, that the phenomena as described are of fundamental importance, or even that they associated with all forms of life.

What, on the other hand, we do know for certain, is that in all living systems in which dynamic events have been adequately studied, the influence of colloidal catalysts is found to be dominant. These catalysts ('enzymes' if you will) exert a specific control over complex chemical reactions, of which the exact co-ordination in time and space is one of the primary characteristics of an organism. It is, I think, difficult to exaggerate the importance to biology, and I venture to say to chemistry no less, of extended studies of enzymes and their action. Of the chemical reactions displayed in an organism few, if any, proceed uncatalysed; while they are reactions so completely and harmoniously organised that all are maintained in complex dynamic equilibrium. If chemical thought is to function with effect in helping towards a description of living systems, it must dwell especially on this chemical co-ordination which, like other aspects of organisation, illustrates that subservience of parts to the whole which characterises an organism.

The organising potentialities inherent in highly specific catalysis have not, I believe, been adequately appraised in chemical thought. The concentration of a catalyst or, alternatively, the extent of its active surface, will determine the velocity of changes due to its influence, but highly specific catalysts determine in addition just what particular materials, rather than any others, shall undergo change. In this respect they are like the living cell itself, for they select from their environment. Finally, the specific catalyst, in virtue of its own intimate structure, determines which among possible paths the course of change shall follow. It has directive powers. Even in a cell juice, or in an extract from living tissues from which all cell structure is absent, experiment has shown that a group of contributory reactions, including syntheses, may proceed in due and just sequence and so lead to the same end result as is normally reached in the intact living system. A striking degree of organisation may indeed be attained in such preparations under the directive influence of the more soluble enzymes derived from the cell or tissue. Much more then must a structured colloidal system, like the intact cell, in which a number of catalysts with such controlling powers are present in circumstances exactly adjusted to a final result, be one in which reactions are conditioned and organised to a high degree without the aid of unknown or any other influences.

I do not expect that all will feel able to admit as much as I myself would like to claim, namely, that the control of events by intracellular enzymes, exerted in the specialised colloidal apparatus of the cell, by itself secures the status of the cell as a system which can maintain itself in dynamic equilibrium with its environment. I am not denying for a moment that the cell has esoteric qualities which may call for organising influences of a greatly different kind; exerted maybe at some higher level. It is at any rate sure that the inter-related activity of highly specific catalysts represents a notable device of Nature which has supported during the course of evolution those dynamic manifestations which characterise living things.

Prof. R. Willstätter, together with members of his school, has done much to advance our knowledge of these agencies. I have sometimes heard it suggested that the advance in question, from a chemical point of view at any rate, represents a relative failure, apparently because no enzyme has yet been isolated in a state to conform with the classical criteria of 'purity'. If this be the reason for any suggestion of failure, there is surely some misunderstanding. Isolation, individualisation and purity are words which, if used at all in this domain, may well need to be given meanings differing not a little from those which are applicable in classical organic chemistry. Few will doubt to-day that the specific influence of a catalyst is due to its specific structure. All indications, however, point to the circumstance that the active structure of an enzyme is supported by a colloidal 'carrier' which stabilises it. It is indeed likely that in very many cases, if not in all, the active catalytic mechanism is a specific configuration at part of the surface of a colloidal particle, or, alternatively, part of a structural surface in the histological sense. If so, we should no more expect to isolate them in a pure state than so to isolate the active areas on a catalytic metallic surface.

It is true that enzymic activity may be displayed by agencies which are not all strictly of one type. It is not unlikely that in certain cases the specifically active groups may be inherent in the structure of a complex but relatively stable molecule, such as that of an exceptional protein. Cases are known indeed in which a protein many times recrystallised retains specific enzymic activity; in one such case at least it has been shown that the protein structure can be to a large extent destroyed without disappearance of the activity. Crystallisation in such a case does not yield an entity which would reveal its active structure to the ordinary methods of organic chemistry. What is essential for enzyme studies at their present stage is an assurance that a single entity alone is responsible for this or that observed activity. To this end the technique developed by the school of Willstätter has greatly helped. While we are waiting for the knowledge which may ultimately yield, on lines acceptable to current chemical thought, a method for characterising these exceptional entities as

units, the actual configuration which confers activity on this or that enzyme can be, and in many cases no doubt soon will be, determined by indirect methods.

I would like now to illustrate a little further the nature of current progress in animal biochemistry by a reference to investigations dealing with related, but somewhat different aspects of control of dynamic phenomena in living tissues.

From the researches published during the year I might select many to show that efforts to disentangle the complexities of these phenomena can in their own way be as profitable as any branch of chemical endeavour. I think it will be more useful, however, to refer more particularly to one research which is typical of many in respect of its methods and its success. In this the investigator approached on new lines a fundamental problem which for the last sixty years has been the subject of speculation, and no less of experiments which up to a point were informative. The problem was to discover the nature of the final chemical steps which lead to the production of urea in the animal body. That the mammalian liver can convert ammonium carbonate into urea has been many times experimentally proved, and it is equally sure that ammonia and, of course, carbon dioxide are continuously produced in metabolism. Therefore most of us have long been content to believe that urea arises by the direct removal of the elements of water from the molecule of ammonium carbonate.

That urea does indeed arise in the liver by a synthesis from ammonia and carbon dioxide remains certain; but the research under reference, brilliantly carried out by Krebs, of Freiburg-im-Breisgau, has shown that its production is on no such simple lines as those mentioned. It calls for a mechanism involving a most interesting interplay among activated molecules. The facts as revealed have just that degree of unexpectedness—if I may use the phrase—which was to be expected in a biochemical phenomenon. I often find myself compelled to assert that though biochemical events are, of course, limited by chemical possibilities, they are not safely to be predicted by chemical probabilities, even when these are strong. That is why experimental biochemistry must remain an independent scientific discipline.

The essential results of Krebs's research include consideration of the molecular structure of three biological substances: ornithin, citrullin and arginin. In the presence of ammonia and carbon dioxide, and when activated by agencies in the hepatic tissue, ornithin is converted into citrullin which, as a ureido-acid, already carries the carbamide structure. Urea does not arise directly from this, however; another stage intrudes. Citrullin takes up another molecule of ammonia (with elimination of water as at the first stage) and the structure of arginin with its guanidin grouping is thus established. Now arginin is the normal substrate for the well-studied and very active hepatic enzyme, arginase; and under its influence the guanidin group is hydrolised. Urea thereupon splits off from the arginin molecule and ornithin is reproduced. The sequence is then re-established.

Urea is thus produced continuously from the ammonia which arises in the deamination of the amino acids of protein, and from the carbon dioxide of metabolic oxidations in general, but on lines which may seem strangely complex. It would be too much to say at present that this is the only line of origin for urea in the body, but we know now that it is the main line. In maintaining the sequence of reactions, ornithin can function in minute amounts; acting therefore essentially as a catalyst. The nature of the relations involved in this mechanism is characteristic of the living cell.

In another respect this example illustrates the nature of current biochemical studies. The data were obtained by the methods of micro-analysis and only a few milligrams of hepatic tissue were employed in individual experiments. Yet the results were consistent and reproducible and experimental errors well under control. The high accuracy to be obtained in ordinary organic analysis by micro methods is now well recognised, but it is becoming clear that technique is so developing that kinetic studies can be made equally accurate on a similar scale. To studies of living systems this offers advantages which cannot be overestimated.

One further point: it is becoming more and more a matter for confidence that when tissues with cells intact are quickly removed from the animal after its death and placed straightway in a fluid medium of carefully proved adequacy, it only remains to provide an adequate supply of oxygen which shall reach each unit of the tissue, to secure the continuance of the events which had been proceeding *in vivo*. Indeed we are gaining sufficient knowledge of the requirements of such excised tissues to justify the claim that the course of metabolism observed in them during extensive periods of survival need differ in no way from the normal.

We can proceed, then, from the study of tissue extracts in which it is easy to deal with the kinetics of isolated reactions, each determined by its appropriate catalyst, to studies of other tissue extracts, made with discrimination, in which the progress of a variety of reactions retains not a little of the organisation which characterised them during life, and thence to other studies in which we follow the kinetics of reactions controlled by the intact and still living tissues or cells. Thus and otherwise has biochemistry escaped from the dilemma voiced in earlier dogma, namely, that since chemical methods must at the very moment of their application convert the living into the dead, they can do nothing to elucidate the dynamic events of life. The escape is more real than may seem on a superficial view, and especially real perhaps to those who are themselves applying modern chemical methods in the biological field.

Forests and Stream Flow

THE effect of the action of forests in conserving water supplies and regulating the flow of water in streams and rivers, whilst preventing erosion in mountainous countries with consequent disastrous floods, has been under discussion for several centuries. Attention was directed to this important matter in an article entitled "Forests, Climate, Erosion, and Denudations" in NATURE of April 4, 1931. The opinions commonly accepted by foresters and many engineers are to the effect that forests are beneficial (1) by retaining and storing water in the humus layer on the forest floor and allowing it to percolate gradually into springs and streams, thus retarding a rapid run-off; (2) retarding the melting of snow in the spring and thus prolonging the run-off from this source; (3) increasing precipitation; (4) preventing erosion on steep slopes. It may be admitted that direct proof of the actual effect of disafforestation of the catchment area of a river on the future water level of that river based on a prolonged series of measurements, has been so far wanting. But the ultimate results, both to the catchment area and the plains country below should reafforestation not take place, cannot be called in question. Europe itself, along the shores of the Mediterranean, and many parts of India offer numerous illustrations of the aftermath of reckless forest denudation, followed by the drying up of water supplies.

In a paper entitled "Forests and Stream Flow" delivered before the American Society of Civil Engineers at its annual convention in Yellowstone Park on July 6, 1932, Messrs. W. G. Hoyt and H. C. Troxall call in question, from the engineers' point of view, the usefulness of forests in maintaining and regulating water supplies. They base their conclusions on the following. An experiment by the United States Forest Service and the U.S. Weather Bureau was conducted from 1910 until 1926 on two contiguous tracts of land in Southern Colorado (Wagonwheel Gap area) of 222·5 and 200·4 acres respectively, having almost identical geographical, topographical and meteorological conditions. The forest cover in both areas was representative of the Rocky Mountain area as a whole. In 1919 the smaller area was disafforested and the slash burnt in 1921. By 1926 the area had become recovered by a growth of grass, herbs and aspen shoots which had reached a height of three to six feet. Throughout the period, accurate measurements of the run-off and meteorological observations were recorded.

A distinct investigation on stream-flow measurements was begun in 1916 under the auspices of the U.S. Geological Survey, in co-operation with the State of California and the County of Los Angeles on certain areas in California. In August 1924 a forest fire burnt some of the areas under observation, and one of them, Fish Creek, was selected to establish the effect of the fire and resulting disafforestation on the discharge of this creek. A new growth appeared over the area burnt, and by the autumn of 1930 it is said that little evidence of the fire remained, though a different plant association had developed.

The investigations recorded by the authors, and the deductions therefrom, are therefore based in the first case on the observations of seven years (1920–1926) and in the second on six years (1925–1930). It is impossible to do more than glance at the conclusions arrived at from the records and data, which are most ably dealt with in this monograph. They are, however, sufficiently startling to require more detailed investigations on the same lines and will merit careful consideration in many parts of the British Empire where forests, agriculture and commercial interests are so inextricably interwoven. Briefly, the authors hold that forests do not conserve the water supply; that the increase of run-off is not confined wholly to flood periods; that after disafforestation in the Wagonwheel area there was an increase of forty-six per cent in maximum daily discharge; that the belief that forests or vegetation covering will increase the summer run-off and shorten the low-level period through the exercise of storage functions is a fallacy, so far as the records on the two above widely differing areas are concerned. Further, that coincident with the increase in the summer run-off there was an increase in the average summer minimum and the period of low water run-off was considerably shortened; disafforestation made no appreciable change in the low flows which occurred during the winter in the Wagonwheel area.

The authors, who are hydraulic engineers, state that they are lovers of the forest, but in the interest of water supplies and the maintenance of water supply levels, they consider that "If the small growth that springs up immediately after disafforestation" (though this is not the case in all countries) "or denudation exercises practically the same effect as forests in reducing normal flood crests and in preventing erosion without the detrimental effect which forest cover is shown to have on annual flow and flow during the summer low-water periods—then in basins where shortages in water supply are becoming critical or where abnormal expenditures have to be made to augment water supplies, the maintenance of forests or reafforestation for the 'conservation of water supply' may have an effect exactly opposite to that desired."

The investigations, which have been carried out in so liberal a spirit by the United States, are of the greatest importance; and they certainly put a question mark to assumptions which have long been held. It is, however, difficult to believe that foresters and many others who have studied this matter will be able to accept all the deductions of the authors when they are based on records of so short a period as six to seven years.

Obituary

DR. WILLIAM PATTEN

DR. WILLIAM PATTEN, who died at Hanover, N.H., United States, on October 27, aged seventy-one years, will be remembered for his numerous contributions to our knowledge of the earliest fossil fishes, which are generally known as Ostracoderms. After graduating as B.Sc. at Harvard in 1883, and as Ph.D. in Leipzig in 1884, he studied at the Naples Zoological Station; and in 1886–89 he was assistant in the Lake Laboratory, Milwaukee, Wisconsin. He was then professor of biology in the University of North Dakota for four years, and in 1893 he became professor of zoology in Dartmouth College, Hanover, N.H., where he remained until his retirement in 1931.

Dr. Patten's researches on the existing *Limulus* and on the fossil Ostracoderms led him to formulate the theory that primitive arachnids were the ancestors of the vertebrate animals. In 1912 he elaborated this theory in a volume entitled "The Evolution of the Vertebrates and their Kin", which was illustrated with his own beautiful drawings. His facts and arguments, however, failed to convince other zoologists and palæontologists, and he accordingly proceeded with astonishing energy to collect new fossils which might illustrate the subject. He prepared the fossils with great skill and patience, and published a series of valuable papers which are filled with original observations. In the province of Quebec, Canada, he found the first specimens of the armoured *Bothriolepis* showing the tail and median fins. In the island of Oesel, Estonia, which he visited on three occasions, he collected numerous other Ostracoderms in a remarkable state of preservation, including new genera and species which still remain to be described. A. S. W.

PROF. A. BOSTOCK HILL

PROF. BOSTOCK HILL, who died on November 5, was educated at King Edward's School, Birmingham, and pursued his medical studies partly at Queen's College—at that time the Birmingham Medical School—and partly at Edinburgh, and he also obtained a medical degree at Giessen. The early part of his career was directed to chemistry and he became public analyst to the county of Warwick and afterwards, in 1879, professor of chemistry in Queen's College. Two years later he was appointed professor of hygiene in Mason College, and then in the University of Birmingham, when this was created in 1900. The whole of his life thereafter was spent in public health administrative work, and he held several appointments under various authorities.

Bostock Hill contributed many useful publications of public health interest, and wrote on the purification of sewage, water filtration, and the spread of scarlet fever by milk. In public lectures and addresses he dealt with such varied subjects as the history of sanitary development in Great Britain, the evolution of the county health department, and the relation of voluntary effort to State authority in sanitary and social reform.

Bostock Hill possessed considerable gifts as a teacher, and his lectures will long be remembered by his students. Since his retirement from Birmingham, he had been a valued member of the Board of Studies in Hygiene of the University of London. A sound administrator, a shrewd man of business, and an attractive personality, he will be missed by a large circle of friends. R. T. H.

WE regret to announce the following deaths:

Mr. Bernard Hobson, formerly lecturer in geology in the University of Manchester, secretary of Section C (Geology) of the British Association at Sheffield in 1910, on December 3, aged seventy-two years.

Prof. Marco Th. Lecco, emeritus professor of chemistry in the University of Belgrade, on November 4, aged seventy-nine years.

Canon John Roscoe, an authority on the ancient customs of the Baganda and kindred tribes, on December 2, aged seventy-one years.

News and Views

Electric Supra-Conduction in Metals

THE account given by Prof. J. C. McLennan, in our Supplement this week, of the discussion at the York meeting of the British Association on electric supra-conduction in metals, is most useful as it shows the progress made both by experiment and theory in elucidating this, at least at present, marvellous phenomenon. As soon as Dewar had succeeded in producing liquid oxygen on a large scale in 1892, he and Fleming made an elaborate research to find out how the resistance of metals varied at very low temperatures. They were led to the conclusion that at temperatures near the absolute zero the electric resistance of pure metals would be very small or even zero. Twenty years later, Kamerlingh Onnes, when experimenting with liquid helium, discovered that, when mercury was cooled down to about 4·2° K., it became suddenly and abruptly what is now called a supra-conductor. At and below this temperature it offers no measurable resistance to an electric current. The flow of electrons round the circuit is practically unimpeded. The importance of this from

the electrical engineering point of view was at once appreciated, for if resistance were annihilated, huge amounts of power could be transmitted great distances by very thin wires. Practical applications, however, are still few and engineers await the further elucidation of the phenomenon by physicists. The action of a magnetic field in delaying the appearance of supra-conductivity wants further explanation. The experiments with direct and alternating currents seem to justify the conclusion that a polarisation or orientation phenomenon of some kind is involved in the production of the supra-conducting state in metals. The electron lattice theory is a promising one but in order to verify it a further study of the conductivity of single crystals at very low temperatures is necessary.

Sir Thomas Purves

THE retirement at the end of last month of Col. Sir Thomas Fortune Purves from the post of engineer-in-chief to the Post Office came after ten years of unparalleled development in the art of electrical communications. During his term of office, he had to decide whether the future of telephony in Great Britain was to be manual or automatic. His decision to adopt the Strowger step-by-step automatic system has been proved by experience to have been of great benefit to the country. His pleasing personality was of great value in the development of international telephony. At the conclusion of the War, everything was favourable for the establishment of an extensive European system, provided that national boundaries could be disregarded. The problem therefore was one of politics rather than of engineering, and it was in this field that Sir Thomas's great gifts as a diplomatist had full play. The disarming charm of his manner, his wit and geniality broke down all barriers. In 1924 he met the representatives of the German administration at the Hague and was successful in persuading them to come to the first international telephone conference which took place in April of that year. Since then, conferences of the C.C.I. (Comité Consultatif International) have been held every year. The retirement of a figure of the type of Sir Thomas Purves from these international deliberations will be very seriously felt throughout Europe. When appointed engineer-in-chief in 1922, he prophesied that the coming ten years would see many remarkable developments—such as full intercommunication between the telephone systems of Great Britain and the United States—all of which have been duly accomplished. Great Britain has become the switching centre through which Europe and America communicate with each other and with the British Dominions. No radio centres in the world are comparable in magnitude with the Post Office transmitting centre at Rugby and receiving centre at Baldock. Sir Thomas is one of the most popular members of the council of the Institution of Electrical Engineers, of which he has been president. We hope he will be able to do equally valuable work for many years to come. His successor at the Post Office is Lieut.-Col. A. G. Lee, chairman of the Radio Research Board.

John Phillips and the Geology of Yorkshire

THE annual meeting of the Yorkshire Geological Society was held at Leeds on November 19. The president, Mr. T. Sheppard, took as the subject of his address the work of John Phillips, the pioneer of Yorkshire geology. As a nephew and companion of William Smith, Phillips had unique opportunities for applying the principles of stratigraphy, and his first book on the subject, "Illustrations of the Geology of Yorkshire. Part 1, The Yorkshire Coast", appeared in 1829 and went through three editions; but of Part 2, "The Mountain Limestone District", there is only one edition, 1836. His other book, "The Rivers, Mountains and Sea Coast of Yorkshire", is of a more popular type and includes an account of the "Ancient Inhabitants of the County". Both show his genius for conveying much solid and original geological work in eminently readable form and also his skill as an artist, the illustrations of scenery and fossils alike being from his pencil. It may here be mentioned that Phillips's fossil types, preserved in the York Museum, of which he was long the curator, have recently been carefully labelled and set out for study by Mr. S. Melmore. While at York, Phillips was one of the founders of the British Association, and Mr. Sheppard mentioned an occasion when he astonished the members by giving, without preparation, a surprisingly complete summary of the year's advances in all branches of science. His later work at Oxford and his well-known "Manual of Geology" were briefly mentioned, but Mr. Sheppard promised that when his address was published it should include a complete bibliography. The task of compiling it could not be in more capable hands.

Prof. Max Weber

IN NATURE for December 9, 1922, there was published a letter of congratulation that had been sent by British zoologists to Prof. Max Weber, of Amsterdam, on the occasion of his seventieth birthday. Of the thirty-five who signed that letter, only twenty-five now survive, and these repeated their congratulations on December 5 last, when the distinguished Dutch zoologist completed his eightieth year. Prof. Weber, who has been a foreign member of the Linnean Society of London since 1898, also received a letter of congratulations from the council of that Society. In the last ten years, Prof. Weber's record of work would have done credit to the vigour of a man of half his age. He has brought out a second edition of his monumental textbook, "Die Säugethiere": he is still producing the successive volumes of the "Fishes of the Indo-Australian Archipelago", in collaboration with Dr. de Beaufort; and the reports of the *Siboga* expedition, written by contributors all over the world, continue to appear under his editorship with a regularity that editors of reports of less important expeditions may well envy.

The British Dyestuffs Industry

THE third report of the Dyestuffs Industry Development Committee on the present position and development of the dyestuffs manufacturing industry

in Great Britain is not characterised by the unanimity of the previous report. While endorsing the general conclusions that the Dyestuffs (Import Regulation) Act is achieving its main objects, that the production of dyes during recent years has been satisfactory, especially taking into account the depressed state of some of the principal consuming industries, and the tribute paid to the extension of the range of products, the quality of the output and the standard of research maintained, as well as the technical and scientific progress, the users representatives dissent from the recommendation of the main Committee that the Act be continued on its present basis for a period of three years. On this point, however, independent representatives on the Committee, Profs. G. T. Morgan and Jocelyn Thorpe, make the reservation that the period of continuance should be five years. They base this reservation on the dependence of the industry upon a systematic application of research and the considerable interval of time which invariably occurs between discovery in the research laboratory of a promising dye and its commercial exploitation.

THE difference of opinion between the users representatives and the majority of the Committee appears to turn on questions of price, the formation of an international agreement and the imposition of a ten per cent tariff. The majority report observes that the effect of the recent agreement between Imperial Chemical Industries Ltd. and the continental makers has yet to be seen, but that there is no reason to anticipate a restriction of the output and activities of the British company. They consider, moreover, that the British makers are still implementing the undertaking to supply at world prices during the continuance of the Act. While the users recommend that the Act should lapse on December 31, 1932, there is no recommendation regarding the tariff, and the recommendation that arrangements should be made for British makers to obtain their supplies of benzene, toluene and xylene at prices corresponding to those paid by their foreign competitors is signed by all members of the Committee.

Land Drainage

THE paper on "Land Drainage in England and Wales", read by Capt. J. C. A. Roseveare, chief engineer of the Ministry of Agriculture and Fisheries, at the winter meeting of the Institution of Water Engineers on December 2, possesses a special interest at the present time by reason of the prominent place occupied by the subject of flood prevention in government and scientific circles, as well as among the general public dwelling in areas subject to inundations as disastrous as those which took place in the Midlands in the earlier part of the present year and in the area of the Don in 1931. The paper commenced with a concise résumé of the origins and constitution of land drainage authorities in Great Britain prior to the passing of the Land Drainage Act of 1930, and proceeded to detail the circumstances attending the institution of the Ouse Drainage Commission of 1925 and the Doncaster Commission of 1926, followed by the Royal Commission on Land Drainage in 1927, the recommendations of which formed the basis of the Land Drainage Act of 1930. The principal feature of this Act was the constitution of a series of catchment boards for the administration of drainage areas comprised within watershed lines to be laid down by the Ordnance Survey Department. The Report of the Royal Commission contained a list of 100 suitable catchment areas, but the Act of 1930 scheduled only 47 for immediate creation. Boards for 46 of these areas, covering 67 per cent of the total area of England and Wales, were actually set up before November 1931.

Catchment Boards

CATCHMENT BOARDS may consist of any number of members not exceeding 31, one member being appointed by the Minister of Agriculture and not less than two-thirds of the remainder by county councils and county borough councils, the whole or part of whose areas lies within the catchment area. As regards the functions of these bodies, Capt. Roseveare went on to state that the special sub-Committee on River Gauging of the Advisory Committee on Water, of which he himself was a member, reported that catchment boards were the proper authorities to undertake the systematic gauging of the rivers of England and Wales, and it advocated these investigations as a necessary preliminary for determining the provision required both for the conservation of water and for the voiding of surplus water in wet periods. Reference was made, in this connexion, to the leading article in NATURE of July 2 and to the discussion on the subject at the York meeting of the British Association in September, which has led to the formation of a special Committee, now sitting, "to inquire into the position of inland water survey in the British Isles and the possible organisation and control of such a survey by central authority". The remainder of Capt. Roseveare's paper was devoted to tabular data and general information, of great value for reference purposes, concerning the various catchment areas and their 'main rivers', with some detailed account of the engineering works recently executed in the basin and estuary of the Ouse.

Geography in Current Affairs

At his inaugural lecture in the chair of geography at Oxford on November 15, Prof. K. Mason, after referring to the development of the School of Geography under his predecessors, spoke more particularly of the geography of current affairs (Oxford: Clarendon Press, 1*s*. 6*d*. net). The subject should entail the study of the earth as the home of man, and a framework of geographical knowledge is an indispensable background in the conduct of human affairs. Many of our present-day troubles he traced to a neglect of the teachings of geography. Much of the guidance that we have for the future comes from a study of the historical past, but to be of use for the future it must be set in the geographical present. The geography of the past,

particularly of prehistoric times, is of less importance to the student than the geography of the world as it is to-day. The geographer can make a definite contribution to the solution of many urgent problems of the day in colonisation, trade, transport and agriculture. Scientific surveys of every aspect of man's environment are much needed and the basis of all this work must be an adequate map. Prof. Mason urged that the appointment of a trained geographical adviser in the government of any country would be invaluable in its development and control.

Lord Bledisloe's Cawthron Lecture

NEW ZEALAND is singularly fortunate in having in its Governor-General, Lord Bledisloe, a keen and distinguished agriculturist, thus representing in the highest governing and administrative circles one of the most important industries of the Dominion. On October 3, Lord Bledisloe delivered at Nelson the annual Cawthron lecture, his address being entitled "A Conspectus of Recent Agricultural Research with Some Reflections Thereon". This is the first time that a Governor-General of a Dominion has delivered within it the chief scientific oration of the year, and as one would have expected, in collating the agricultural research of the past three years, as Lord Bledisloe did in the lecture, the economic importance of agricultural research has been emphasised from an essentially broad though authoritative point of view, thus taking into consideration not only the British Empire, but also other countries. The amount of detailed facts, with commentaries, concerning agriculture which have been assembled into this lecture is scarcely short of amazing. Lord Bledisloe has left no stone unturned in his search for data. Every aspect of agricultural and horticultural research is reviewed and there is scarcely a research department, institute or station within the British Empire which is not considered and its recent work discussed. Other countries outside the Empire, such as Denmark, Germany, the United States, Holland, Finland and others, have been combed for results and duly considered. Apart from the general consideration of horticulture, arable and dairy farming and apiculture, and their more detailed aspects such as the study of the constitution of wool, vitamins, etc., researches in connexion with more specialised Empire products such as sugar and tobacco are also reviewed. The lecture has now been published and may be obtained from Messrs. Whitcombe and Tombs, 3 Addle Hill, London, E.C.4, price 1*s*.

Expansion of the Universe

AT the Friday evening discourse on November 25 at the Royal Institution, Dr. Knox-Shaw discussed the observational evidence for the expansion of the universe. The nebulæ lying beyond our galaxy stretch away into space farther than our present limit of penetration. Most of them can be studied only with our largest telescopes, and for our knowledge of their distances and motions we are indebted largely to the work of Dr. Hubble at the Mount Wilson Observatory. In some forty nebulæ he has been able to detect individual stars, and in a few cases to identify them as belonging to types already known in the galaxy. From the apparent luminosities of these stars he has derived distances for the nebulæ in which they are involved. In all other cases the distances are based on the apparent brightness of the nebulæ themselves. The scale of distance thus constructed is still very uncertain. The absorption lines in the spectra of the extra-galactic nebulæ are shifted towards the red in a way that suggests that they are all moving away from us with velocities which increase with the distance. Whether there is an alternative explanation of these shifts is a question for the physicist rather than for the practical astronomer, but if we assume that they actually indicate motions of recession, we find that the velocities of the nebulæ are proportional to their distances from us, as would be required in a uniformly expanding universe. Hubble's value for the rate of expansion, an increase of 560 km. a second for each million parsecs of distance, must be regarded as liable to revision as further observational material becomes available. A cluster of very faint nebulæ in Gemini, so remote that its light has taken some 135,000,000 years to reach us, has recently been photographed at Mount Wilson, and seems to be moving away from us at the immense speed of 24,000 km. a second.

Slaughter-Houses in Great Britain

THE eleventh Benjamin Ward Richardson memorial lecture was delivered, under the chairmanship of Sir James Crichton-Browne, before the Model Abattoir Society on November 30 by Mr. T. Topping, who chose for his title "The Slaughter-House Problem". He commenced by saying that had local authorities more generally carried out the advice given by Richardson when he founded the Model Abattoir Society fifty years ago, there would have been no slaughter-house problem to-day, and there would have been greater benefit for other public health protective measures. As it is, there is a very real problem owing to the fact that the slaughter-house provisions of the Act of 1847 are still the principal law on the subject to-day. No advance was made by the Public Health Act of 1875, so that many buildings quite unsuitable for the purpose came into existence as private slaughter-houses. The Rural District Council (Slaughter Houses) Order of 1924 gave State recognition to and largely increased the capital value of hundreds of unsuitable buildings that had been erected as slaughter-houses prior to the order. Thus for nearly sixty years, most local authorities steadily increased the financial difficulties of providing for the only effective means of supervision of slaughter-houses and of securing hygienic preparation of carcase meat. According to Mr. Topping, there are only about 110 slaughter-houses in Great Britain where the buildings and arrangements are satisfactory, whereas in a large percentage, complete supervision and inspection is extremely difficult if not impossible. As a solution of the problem, he suggested first that the Ministry

of Health should obtain either directly, or indirectly through the county councils, information as to the condition of all the private slaughter-houses in the country, particularly as to deficiencies in meat inspection and their cause, and secondly, that abattoir provision should be on a county basis, instead of allowing each local authority to have its own abattoir.

Ultra-Short-Wave Wireless Communication

IN his Friday evening discourse at the Royal Institution on December 2, the Marchese Marconi described the important results of his recent investigations into the properties and behaviour of very short electric waves. Numerous distance tests and a few official demonstrations have been given from time to time, and each has proved the availability and practicability of these waves for the purposes of radio communications. Soon after a duplex demonstration over a distance of twenty-three miles between Santa Marghorita and Sestri Levante, the Vatican authorities decided to adopt the new system for telephonic communication between the Vatican City and the palace of the Pope at Castel Gandolfo, a distance of 20 kilometres entirely over land, and screened by intervening trees. In connexion with the establishment of this service, successful tests took place towards the end of April this year; during one of these tests waves had to pass through all the masts and aerials of the high power radio station of the Italo Radio Company at Terranuova. Following a series of experiments with waves of the order of 50 centimetres length conducted between Marconi's yacht *Elettra* and the station at Rocca di Papa, near Rome, the most outstanding result was the successful establishment of communication from Rocca di Papa to Cape Figari, Sardinia, over a distance of 168 statute miles (275 kilometres) on a wave-length of 57 centimetres. All previous distance records of communication by means of wave-lengths less than one metre were thus far surpassed, and it was effectively demonstrated that these very short waves can overcome the supposed obstacle presented by the curvature of the earth, the distance between the two stations being considerably in excess of the optical range. A new technique is thus developed which is bound to extend very considerably the already vast field of the applications of electric waves to radio communications. The new system is unaffected by fog, and offers a high degree of secrecy, by virtue, principally, of its sharp directive qualities.

Radio Equipment for Cross Channel Air Services

IN March 1931 a demonstration was given by the International Telephone and Telegraph Laboratories of radio telegraphic communication across the English Channel on a wave-length of about 17 cm. (see NATURE of April 11, 1931, p. 564.) According to a note in the *Electrician* and the *Electrical Review* for November 18, a somewhat similar equipment to that used in the above demonstration has been ordered by the Air Ministry for use in connexion with cross-Channel flying services. This equipment will be manufactured by Messrs. Standard Telephones and Cables Ltd. in their Hendon factory, and it will operate on a wave-length in the neighbourhood of 15 cm. The oscillations corresponding to this wave-length will be generated by special valves and will be led to the transmitting aerial, which is less than one inch long, situated at the focus of a circular reflector about 10 ft. in diameter. This reflector will be focused on to a similar reflector at the receiving station. The equipment ordered by the Air Ministry will be located at the Lympne air-port, near Hythe, and will operate in conjunction with a similar equipment ordered by the French Air Ministry to be situated at St. Inglevert aerodrome, nearly seven miles south-west of Calais. It will be used for announcing the arrival and departure of aeroplanes that are not fitted with radio, and for routine service messages. An interesting feature of this new service will be the use of teleprinters for both receiving and transmitting messages. In this way typewritten messages will actually be sent across the Channel by radio, thus providing a permanent record at each end. It is expected that the station will be in operation early next spring and its use will relieve the volume of traffic at Croydon and Lympne radio stations very considerably.

Scientific Expedition to Yunnan

IN the spring of 1932 a joint botanical and zoological expedition was sent to eastern Yunnan by the Fan Memorial Institute of Biology, Peiping, starting from western Szechuan and exploring the bordering regions of Szechuan, Kweichow and Yunnan. The party expects to spend the winter in Yunnanfu. The botanical staff will endeavour to explore regions formerly not thoroughly worked over and collect also specimens in the type localities. Besides collecting flowering plants, special attention will be devoted to mosses, liverworts, ferns and other cryptogams. The zoological staff will collect birds, fishes, other lower vertebrates and land shells. News has been received that the party succeeded in penetrating the forbidden territories of Ta-Liang-Shan Lolos, where probably no white man has ever entered before. These Lolos are very war-like tribes. They frequently kidnap Chinese and make them slaves. By a curious chance the present powerful chieftainess is the sister of the military governor of Yunnan, and hence much more enlightened in her view toward the purpose of scientific expeditions. The party was welcomed as honourable guests by the chieftainess. Oxen and pigs were slaughtered in their honour, and an elder of the tribe has been handed over to the district magistrate as the pledge of their safety. As two years ago the lamentable death of the eminent young Chinese palæontologist, Ya-Tseng Chao, at the hands of bandits had cost the district magistrate of Chao Tung Hsien permanent dismissal from office, such precaution is carefully taken by his successor. The party plans to explore the south-eastern part of Yunnan next year.

Popular Science

To apply the term 'popular science' to a book is generally sufficient to make a man of scientific training turn aside distrustfully. This is particularly unfortunate in these days of increasing specialisation, when it is more than ever desirable that specialists should be enabled to follow broad lines of advance in fields other than their own, but the fact remains that most popular science books are 'written down' and simplified to the point of sheer inaccuracy. There is also an increasing body of laymen interested in the advances of science who rightly ask to have accurate though plain accounts of current work. Davy and Faraday showed one way in which both needs can be met: the scientific worker can come from his laboratory and explain his investigations. Faraday's Friday evening discourses at the Royal Institution are still regarded as models of exposition, and it may justly be said that Faraday's mantle has fallen on the present occupant of his post, Sir William Bragg. Sir William's course of Christmas lectures of 1923-24, "Concerning the Nature of Things", forms an admirable introductory volume in a group of four published by Messrs. G. Bell and Sons, Ltd., in a new "Popular Science Series" (4*s.* 6*d.* net each). From that we may pass to "Engines", by Prof. E. N. da C. Andrade, another course of Christmas lectures at the Royal Institution, and then perhaps to Prof. J. Kendall's "At Home among the Atoms", described by its author as "A First Book of Congenial Chemistry", which with its quaint chapter headings and unconventional diction will amuse as well as inform. Finally, there is Prof. Andrade's "The Mechanism of Nature", a more ambitious work for the intelligent reader, surveying in plain language modern views on the structure of matter and radiation. All these books have been published before, but in their new and tasteful 'dresses', any or all of them might well serve to solve the problem of the selection of a Christmas present for a young or an older reader.

Electrically Heated Incubators

THE use of electrically heated incubators is steadily increasing. Some people think that the method is a risky one, as the interruption of the electricity supply even for a short period might involve a failure. We learn from the Electrical Development Association (the E.D.A.) that this risk is negligible. For example, a leading firm of poultry farmers and incubator manufacturers sent batches of eggs in its incubators to agricultural shows. In one case, two batches, 219 eggs in all, were sent to the Royal Show at Southampton. One batch had been incubated for thirteen days and the other for fifteen. After being taken out of the incubators at the farm they were packed in egg-boxes and carried in a loaded three-ton lorry a distance of sixty miles by road to the show. They were then unpacked and placed in the incubator. At the end of the normal periods 209 chicks were hatched. The eggs were out of the incubator for a very much longer period than any interruption in an electricity supply is likely to last. Another case is described where the half-incubated eggs were packed in the ordinary way and sent 240 miles by road and train without any apparent effect on the number of chickens hatched.

Institution of Automobile Engineers' New Journal

THE Institution of Automobile Engineers had its birth in 1898 at Birmingham, as the Cycle Engineers' Institute, and took its present title in 1906, when its headquarters were removed to London. In 1911 it had a membership of 530, while to-day it has a membership of 2,520, with seven provincial centres and a branch in New Zealand. Up to the present, it has only issued leaflets devoted to the papers read and other matters, while the *Automobile Engineer*, published by Messrs. Iliffe and Sons, Ltd., has been considered as its official organ. It has now, however, been considered desirable that the Institution should have its own monthly journal, and the first issue of this has recently appeared. The *Journal* is intended to include advance copies of papers to be read, summaries of the discussions which take place, abstracts of papers and articles from other sources and reviews of books of special interest to members. This is certainly a step in the right direction and one which will be generally appreciated. Last year the Institution formed a Research and Standardisation Committee and appointed a director of research and the first issue of the new *Journal* includes the annual report of the Committee for the year July 1, 1931–June 30, 1932.

Armstrong College Mining Society

THE July number of the *Journal of the Armstrong College Mining Society* has recently been issued. Probably the most important paper in it is one by Prof. Granville Poole and Mr. J. T. Whetton on "Skip Winding", showing how this method is being adopted in a number of German mines, even in certain collieries. It is doubtful to what extent this method of winding is applicable to British collieries, but its use should, no doubt, be carefully considered. It has, of course, been used for many years as the main method of winding in the metalliferous mines of Cornwall, although the authors of the paper appear to have overlooked this fact entirely. It may also be pointed out that they make no allusion to the methods which have been recently tried in Germany of constructing skips of material lighter than steel. Another interesting paper is one by Mr. M. T. Adamtchik on the so-called 'Aeroto' fan, which apparently is simply a multiple propeller fan. Curiously enough, the author makes no reference to the Stoart fan, which was the first type of propeller fan ever employed; it would appear that the fan here described is simply a development of the latter fan. The *Journal* concludes with a glossary of mining terms, with French and German equivalents, which unfortunately are not always correct.

Taxonomy of the Hymenomycetes

THE presidential address of Mr. A. A. Pearson to the British Mycological Society reviews the European

(*Continued on p.* 887)

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Electric Supra-Conduction in Metals*

By Prof. J. C. McLENNAN, O.B.E., F.R.S.

THE discussion at the York meeting of the British Association on the electric supra-conductivity of metals was opened by a reference to the classical experiments of Dewar and Fleming[1] made in 1893 on the electrical conductivity of metals cooled to very low temperatures by means of liquefied gases, including air and hydrogen. These yielded results suggesting that the electrical resistances of all pure metals would vanish at the absolute zero of temperature.

This suggestion, however, proved to be wrong, for in 1911, Kamerlingh Onnes at Leyden, while carrying out researches at low temperatures with the aid of liquefied helium, discovered that mercury, when cooled down and solidified with liquid helium, suddenly and abruptly at about 4·2° K. became what is now designated as a supra-conductor of electricity. At temperatures below 4·2° K., mercury offers no measurable resistance to the passage of a current. Currents of electricity started in a ring of a metal in the supra-conductive state will continue apparently undiminished in intensity while the metal is in that state. The duration of these persistent induced ring currents seems to be limited only by the length of time the cooling agent, liquid helium, will last. In the course of a lecture on the evening of June 3 last at the Royal Institution on supra-conduction in metals, I exhibited to the audience a closed ring of lead immersed in liquid helium and carrying a current of more than 200 amperes. The current had been started in the supra-conducting lead ring some six hours earlier in the afternoon by Prof. Keesom in Leyden, and *it persisted undiminished in intensity while being* transported in liquid helium by aeroplane from Leyden to London by Colonel the Master of Sempill.

* From a discussion on electric supra-conduction in metals held in Section A (Mathematical and Physical Sciences) on Friday, September 2, at the York meeting of the British Association. Among those who took part in the discussion were Prof. J. C. McLennan, Prof. W. J. de Haas, Dr. W. Meissner and Prof. O. W. Richardson.

SUPRA-CONDUCTIVE METALS

Metals in addition to mercury and lead that exhibit the supra-conductive property if made sufficiently cold are tin, indium, gallium, thallium, tantalum, titanium, thorium, and niobium. The transition temperature for the passing of a metal from the ordinary conducting to the supra-conductive state is not a constant but varies with the metal. For mercury it is 4·22° K., for lead 7·2° K., tin 3·7° K., tantalum 4·4° K., thallium 2·37° K., indium 3·37° K., gallium 1·05° K., thorium 1·5° K., titanium 1·75° K., and niobium 8·2° K.

ALLOYS AND CHEMICAL COMPOUNDS

Some alloys and chemical compounds of the metals also exhibit the supra-conductive property. Copper sulphate, for example, does so, though none of the constituent elements is a supra-conductor. The nitrides and carbides, borides and silicides of several of the metals, such, for example, as those of molybdenum, tungsten, tantalum, zirconium and niobium, are also supra-conductive at sufficiently low temperatures.

The addition of metals of the bismuth group to supra-conductive metals has been found, speaking generally, to raise their transition temperature. Bismuth added to lead raises the transition temperature from 7·2° K. to 8·8° K.; carbon raises that of niobium from 8·2° K. to 10·5° K. Gold

alloyed with bismuth becomes supra-conductive at 1·94° K., whereas neither constituent alone becomes supra-conductive even at the lowest temperatures obtainable.

With pure metals the transition from the ordinary conductive to the supra-conductive state generally occurs within a tenth or at most a few hundredths of a degree. With impure metals, with alloys or with chemical compounds, the transition is not generally so rapid. In the transition stages, in the case of most of the metals the variation of resistance can be readily followed by observing the vapour pressure of the liquid in which the metal is immersed. In the case of liquid helium, a variation in vapour pressure of about 40 mm. of mercury corresponds to about one tenth of a degree centigrade.

Recently McLennan, Allen and Wilhelm, in making a study of various alloys of the silver-tin, gold-tin, gold-lead systems, found three outstanding features to characterise the results. First, in alloys with the supra-conductive elements it was observed that gold and silver produced an effect on the transition temperature opposite to that produced by bismuth, antimony and arsenic. When one observes alloys containing the latter metals, one finds usually a pronounced elevation of the supra-conducting temperature, while in alloys with gold and silver one finds an equally pronounced depression of the supra-conducting temperature. Secondly, it was noted that a binary alloy system composed of a supra-conductor and a non-supra-conductor does not necessarily have a unique transition temperature. Thirdly, it was found that with the alloy systems, silver-tin, gold-tin, gold-lead, the transition temperatures were higher for eutectic mixtures than for chemical compounds of the two metals constituting the alloys. The data compiled in Table I will serve to illustrate these points. The element silver and the compound Ag_3Sn, it will be seen, have not been found to be supra-conductors at any temperature reached up to the present.

TABLE I

Tin-Silver Alloys

Substance	Mixture	Percentage of Tin	Transition temperature
Tin	Pure	100	3·76° K.
Silver and tin	Eutectic alloy	96	3·52° K.
$Ag_3Sn + Sn$	Eutectic alloy	50	3·57° K.
Ag_3Sn + 3 per cent Sn	Mixture	30	2·3° K.
Ag_3Sn	Compound	27	—
Silver	Pure	0·0	—

Mechanical Strains and Thermal Dilatation

The application of mechanical stresses such as those of torsion and tension raises the transition temperature of a supra-conducting metal, but observations made on the thermal dilatation of a lead rod showed no discontinuity when its temperature was lowered as it passed through the transition temperature, 7·2° K., from the ordinarily conducting to the supra-conductive state.

Action of a Magnetic Field

The application of a magnetic field delays the appearance of supra-conductivity and causes it to appear in a metal at a lower temperature than normally.

If a metal in the supra-conductive state be subjected to a gradually increasing magnetic field, a critical field strength is reached when electrical resistance re-appears in the metal. The strengths of the critical fields required for different supra-conductors vary; an alloy of bismuth and lead, for example, at 1·2° K. requires a magnetic field of 20,000 gauss to restore the property of electrical resistance, while metallic thallium at the same temperature requires a field of only 15 gauss.

Since the electrical resistance of supra-conductive metals is zero, no heat is produced when electrical currents are passed through them. Currents of high intensity can therefore be passed through supra-conductive wires of small diameter without melting them. Electric currents of more than 1,000 amperes have been so obtained in wires of small cross-section. The factor that imposes a limiting value upon the current strength is the magnetic field set up in the wire by the current itself. A critical value is reached when resistance is restored to the wire by the magnetic field.

Owing to the fact that metals in the supra-conducting state have no electrical resistance, currents of electricity induced in rings of metals in this state will persist with undiminished intensity so long as the metals remain supra-conductive. So far, it has been found impossible to detect with instruments of precision any diminution in the intensity of ring currents in supra-conductors even after the lapse of a period so long as thirteen hours.

Recently some experiments were carried out

by McLennan, Allen and Wilhelm on the intensities of persistent currents of electricity induced in rings having the same dimensions of lead, tin and tantalum, brought into the supra-conductive state by the use of liquid helium. The currents in the rings were induced by the magnetic field provided by electric currents established in a circular coil of wire placed in turn coaxial with and close to each of the supra-conducting rings. The results of these experiments are represented by the graph shown in Fig. 1. It was found that, for the weaker magnetic fields, equal changes of flux produced currents of equal magnitude in each of the three supra-conductors. The magnitude of the persistent current developed depended not on the substance of the supra-conductive ring but only on its dimensions and on the magnitude and form of the inducing magnetic field.

The case of tin is very interesting, since the values of the current in it agree with those of the current in the others only up to fields of about 25 gauss. For inducing fields higher than this amount the strength of the persistent current dropped off. Above this point, then, part of the ring must have been in a magnetic field, the strength of which had reached the critical value where resistance re-appeared, that is, an inner layer of the ring must have become non-supra-conductive. As the field was increased above this point, one can suppose the outside supra-conductive portion of the ring became thinner and thinner until the whole ring became non-supra-conductive.

The fact that the same flux engenders the same persistent current in different supra-conducting metals having the same size and form follows from an application of the equation

$$L\frac{di}{dt} = \frac{dB_A}{dt} \quad \text{or} \quad i = \frac{B_A}{L}$$

For rings of the same dimensions, the self-inductances would be identical; and in the supra-conducting state the resistances of the three metals would be vanishingly small. Self-induction and zero resistance were the two factors that made the magnitude of the induced current in different supra-conductors the same.

Looking at the matter in another way, we see that the induced currents in the three supra-conductors must be the same since the magnetic field of the persistent current must be equal in magnitude and distribution but opposite in direction to the flux of the exciting field.

Alternating Fields

Since the discovery of the phenomenon of supra-conductivity in metals by Kamerlingh Onnes in 1911, researches in this field have been until recently almost invariably carried out by the use of unidirectional electric currents. No systematic attempt appears to have been made hitherto to investigate the phenomena of supra-conductivity with alternating electric currents of high, medium and low frequencies.

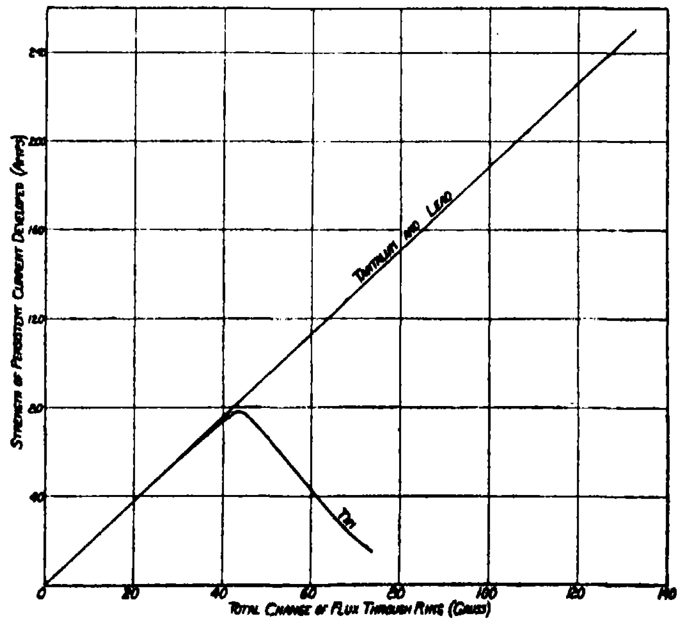

Fig. 1.

Some of the theories[a] put forward to explain supra-conductivity suggest that an orientation of some kind is involved in the production of the supra-conducting state in metals. If this suggestion should prove to be correct, one would expect some modification of the phenomenon for currents of high frequency. It need only be mentioned that all 'orientation' effects are considerably modified in an oscillating field with a time-period of the order of, or less than, the 'time of relaxation' of such orientation. A well-known example is that of the dielectric constant, which rapidly diminishes in value for very high-frequency electric fields. As to 'relaxation times', it will be recalled that in the case of ice, experimental evidence shows

that the relaxation time is of the order of 10^{-4} sec. at 0° C. and rapidly increases as the temperature is lowered.[3] It would not seem unreasonable then to expect to find 'relaxation times' exhibited by metals in the supra-conducting state, provided one used in one's experiments alternating fields of suitable and adequate frequencies. A short time ago an investigation was initiated in this direction by McLennan, and through a set of researches carried out successively with the collaboration of a number of his associates, namely, Niven, Wilhelm, Burton, Allen, Smith, McLeod and others, the work recently culminated in the discovery that such metals as lead, tin and tantalum can be made to exhibit, when in the supra-conducting state, characteristic phenomena that point to their possessing 'relaxation times' roughly of the order of 10^{-7} sec. or 10^{-8} sec.

Absorption of β-Rays by Supra-Conductors

In the first of these researches[4] the absorption of β-rays by a thin sheet of lead was investigated when the lead was gradually cooled from a temperature a few degrees above to a few degrees below the critical transition temperature of 7·2° K. The β-rays used were those emitted by mesothorium and the lead sheet had a thickness sufficient to absorb, at ordinary room temperature, 50 per cent of the β-rays issuing from the mesothorium. In these experiments no measurable variation or discontinuity was detected in the absorption coefficient as the temperature of the lead was lowered through the critical value 7·2° K. The high-velocity electrons from the mesothorium apparently encountered just as much resistance in their passage through the lead with the latter in the supra-conducting state as when the lead possessed the normal conductivity exhibited at the higher temperatures. This investigation gave definite proof that although resistance in the supra-conducting state is zero, or a very low value for currents carried by slow-moving electrons, it is not zero but maintains a normal value for currents carried by high-speed electrons.

Looking at the matter in another way, this result indicates, if the de Broglie wave equation $p = h/mv$ applies, that lead at the lowest temperatures cannot exhibit supra-conductivity when subjected to alternating electric fields with frequencies of the order of 10^{11} per sec.

Photoelectric and Light Absorption Experiments

In a second series of experiments,[5] thin films of lead were deposited on plates of glass and of quartz, sometimes by cathode spluttering and at other times by vaporisation of metallic lead. These films were subjected to a series of decreasing temperatures commencing a few degrees above 7·2° K. and ending at the temperature of liquid helium, 4·2° K. The photoelectric effect and the absorption of visible light were in turn investigated with these films and measurements were taken approximately by steps of a fraction of a degree as the temperatures of the films were lowered. In these experiments no measurable discontinuity was observed in the results of the measurements on the photoelectric effect, or in the results of those on the coefficient of absorption of the light waves when the lead films traversed were passed through the transition temperature of 7·2° K. These results were taken therefore to indicate that supra-conductivity with lead is a phenomenon that cannot be exhibited when electric fields alternating with a frequency approximately equal to or greater than 10^{14} per second are used.

It is clear, however, since supra-conductivity can be brought into evidence by the use of unidirectional fields, that is, with fields of zero frequency, that there must exist some critical alternating field with a frequency between zero and 10^{14} per second, by the use of which supra-conductivity should just be detectable.

Experiments with Electric Fields of Radio-Frequencies

Through the development which has taken place in recent times, it is a comparatively simple matter to arrange combinations of oscillating valve systems capable of providing alternating electric fields with frequencies so high as 10^7 or even 10^8 per second. Some experiments were therefore made with radio fields having frequencies approximating to 10^7 cycles per second and corresponding to a wave-length of about 30 metres. With fields of this frequency, it was thought that the phenomenon of supra-conductivity might appear with lead at a lower temperature than 7·2° K., might even be only partial, or might not appear at all. The experiments[6] and apparatus used, together with the theory applicable, have been

fully described elsewhere and it will suffice to give here only a summary of the results obtained.

It was found that with currents of frequency $1{\cdot}1 \times 10^7$ per second a coil of lead wire showed an abrupt loss of resistance, of relatively large amount, at a temperature that appeared to be slightly lower than the critical temperature 7·2° K. characteristic of the transition to supra-conductivity, found for the same wire with direct current.

In a series of repeated experiments with a coil of tin wire, drawn to a diameter of 0·3 mm., it was found that with direct currents the resistance of the coil began to decrease abruptly at 3·76° K. and disappeared completely at 3·70° K. Experiments with the same coil with currents of frequency $1{\cdot}1 \times 10^7$ per second gave for the corresponding temperatures 3·67° K. and 3·61° K., that is, supra-conductivity did not begin to appear until a temperature was reached that was below the one at which it was complete in the case of the direct current experiments. Further experiments with higher frequencies revealed depressions of the critical transition temperature increasing in amount with the frequency. Extrapolation of the transition temperature – frequency curve, which appeared to be linear for the higher frequencies, gave 10^8 per second for the frequency corresponding to 0° K.

With tantalum wires and with wires of a bismuth-lead alloy, results were obtained similar in character to those found with wires of tin and of lead. Experiments with tin wire coils showed that the observed depression of the critical temperature was not dependent upon the magnitude of the high-frequency currents in the coils and was therefore attributable neither to the heating of the coils above the temperature of the surrounding liquid helium, nor to the effect of the magnetic field of the currents. Experiments with wires of different sizes made with currents of the same frequency showed that the depression of the transition temperature was not a direct function of the skin effect. It would appear, then, to be a function of the frequency of the current in the metal alone.

Experiments with Simultaneous Direct and Alternating Currents

Some interesting results have been obtained by passing direct and alternating currents simultaneously through supra-conductors.

In one of these experiments a tantalum conductor in the form of a solid wire was used. The graph given in Fig. 2 shows the results obtained. The magnitude measured was the direct current resistance, and the curves show that the presence of the high-frequency currents delayed the initial appearance of the approach to the supra-conducting state and enhanced the direct current resistance in the transition stages. The temperature at which supra-conductivity was complete according to the D.C. measurements was not, however, affected by the presence of the high-frequency current in the wire. This was due, of course, to 'skin effect', for the disturbing action of the high-

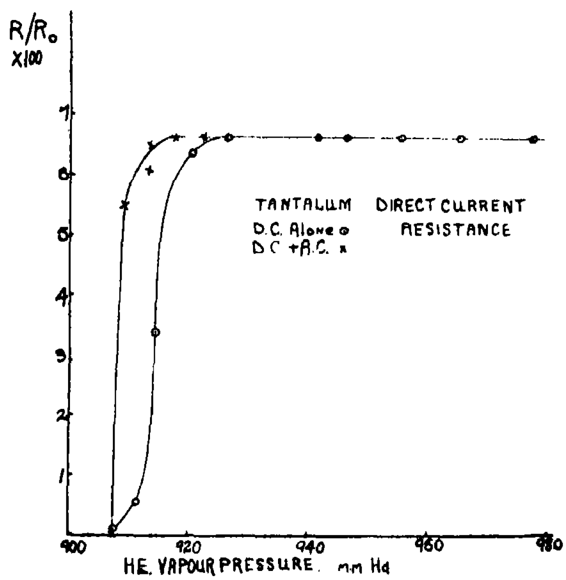

FIG. 2.

frequency currents when the wire was at a sufficiently low temperature to be supra-conducting for D.C. measurements was confined entirely to the outer layers of the wire.

In another experiment which was rather instructive, a conductor was constructed by 'wiping' a layer of block tin upon a *constantan* wire, of diameter 0·016 cm. The tin skin was of average thickness about 1/500 mm., and its presence decreased the resistance of the wire at room temperature by about seven per cent. Calculation shows that at the low temperatures just above the supra-conducting point the resistance of the constantan was then about thirty times that of the tin.

The results of measurements made with this wire are shown by the graphs of Fig. 3, which represent the relation between the direct current

resistance ratio R/R_0 and the temperature, both without high-frequency currents present, and with the high-frequency and direct currents flowing simultaneously in the metal.

It can be seen that when, in addition to the direct current, high-frequency currents were passed through the wire, the resistance was changed so that the curve AB first obtained was shifted to lower temperatures, becoming the curve $A'B'$. The switching on and off of the high-frequency generator changed the resistance reversibly from

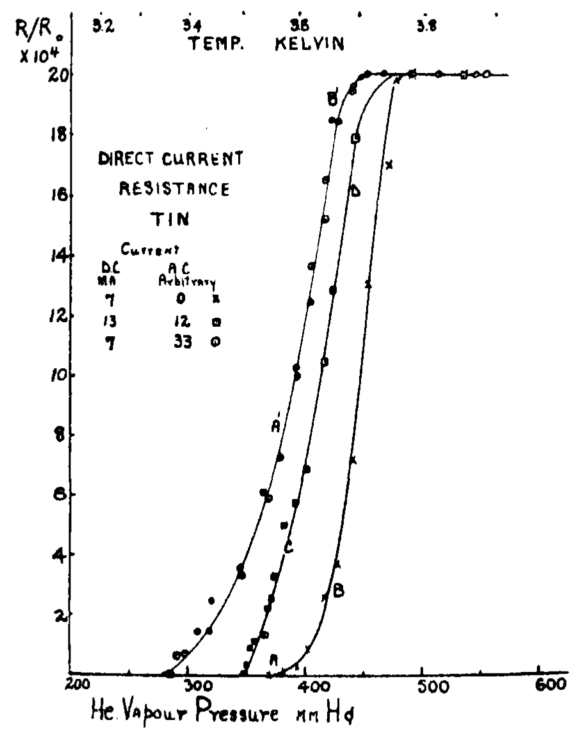

FIG. 3.

the point A to A', B to B' and so on. The magnitudes of the shifts A to A' and B to B' increased, as the curves show, with an increase in the ratio of the strength of the high-frequency current to that of the D.C. one. Even when the resistance had become zero on the undisturbed curve it could be partially restored to the tin layer by switching on the alternating current. Moreover, the curves clearly show that the presence of alternating high-frequency currents in the tin coating on the wire had the effect of lowering the temperature at which with D.C. measurements the tin layer became supra-conducting.

It may be of interest to state that when observations were made with this tin-coated wire on the resistance it offered to high-frequency currents, it was found that the addition to it of a direct current had the effect of removing partially or wholly the high-frequency resistance. The graphs in Fig. 4 illustrate this point.

The results of the experiments with high-frequency alternating currents would seem to justify the conclusion that a polarisation or orientation phenomenon of some kind must be involved in the production of the supra-conducting state in metals.

In the discussion, Prof. W. J. de Haas expressed the view that it seemed probable that the electrons go over into a new phase when the metals become supra-conductive, and in order to support this view certain experiments had been carried out by him and his associates on the conductivity of single crystals. Formerly the region of disappearance of resistance was about 0·03°, but he had found that for good single crystals and small measuring currents this region did not exceed 0·0005°. He and his associates had investigated the influence of the crystal lattice on grey and white tin, which differ only in this respect that grey tin does not show supra-conductivity, while white tin does. Gold-bismuth alloys show the same influence—the alloy becomes supra-conductive though neither of the components do. X-ray experiments, however, showed that this alloy has a crystal lattice of its own.

Investigations of the thermal conductivity of supra-conductors shows an influence of the supra-conductive state. At the transition point, indium shows a small sudden increase of thermal conductivity. When the supra-conductivity is disturbed by a magnetic field, the thermal conductivity is increased for pure metals. The results for $PbTl_2$ are very complicated, probably as a result of the lack of homogeneity of the alloy. The specific heat of tin increases when the metal becomes supra-conductive. In a magnetic field high enough to disturb supra-conductivity, this increase disappears.

Prof. O. W. Richardson pointed out that there is some resemblance, even though it may be only superficial or accidental, between supra-conductivity and ferromagnetism. Following this idea, Keesom and his associates at Leyden have measured the specific heat of supra-conductors in the neighbourhood of the critical point, where one might expect an abnormality similar to the abnormality in the specific heats of ferromagnetic substances in the neighbourhood of the Curie point; but no such effect could be detected. This, however, is not entirely conclusive. The

number of electrons concerned in the supra-conductive phenomenon may be too small a fraction of the total number, or of the number of atoms present, to exert any appreciable influence on the specific heat, or, alternatively, there may be some compensating effect on the atoms which may counterbalance any changes in the specific heat of the whole substance arising from changes in the energy of the electrons.

Dorfman has pointed out that a test which is in some respects a more direct one of this particular issue can be made if the specific heat of electricity (Thomson effect) in the supra-conductive region of temperature is considered. The magnitude of this effect can be deduced from the thermoelectric measurements of Keesom and his associates which refer to lead and tin. These show that there is such an abnormality in the Thomson effect. It is true that it does not occur exactly at the supra-conductive critical temperature. For example, in the case of lead this critical temperature is 7·2° K.; whereas the anomaly in the Thomson effect sets in at about 5° K. and rises to a maximum at a little above 10° K., after which it falls. This anomaly is quite similar to the corresponding anomaly in the case of ferromagnetic substances near the Curie point.

If it is admitted that this anomaly in the Thomson effect is associated with the establishment of supra-conductivity, it is a natural inference that it is a result of the change in the energy of an electron connected with this phenomenon. On this basis, the thermoelectric data enable the difference ΔW_0 between the energy of a supra-conducting and a non-supra-conducting electron to be estimated. The interesting fact then emerges that, approximately,

$$\Delta W_0 = \mu H_0 = h\nu_0$$

where μ is the spin moment of the electron, H_0 the magnetic field necessary to destroy the supra-conductivity, h is Planck's constant, and ν_0 McLennan's destructive frequency; ΔW_0, H_0 and ν_0 are all extrapolated to the absolute zero of temperature. In other words, the magnetic energy and the vibrational energy required to break up the supra-conductive structure are each approximately equal to the energy of the structure itself.

Dr. W. Meissner described experiments in which very slow-moving electrons are made to impinge upon a sheet of tin-foil at temperatures both above and below the transition temperature of tin, 3·7° K. His object was to see whether the foil when supra-conductive is transparent to such slow-moving electrons. It was found not to be so, although by his experimental arrangements the velocities of the impinging electrons after their entrance into the tin-foil were probably not greater than the velocities with which the conducting electrons in the metal, according to recent theories, are supposed to be endowed.

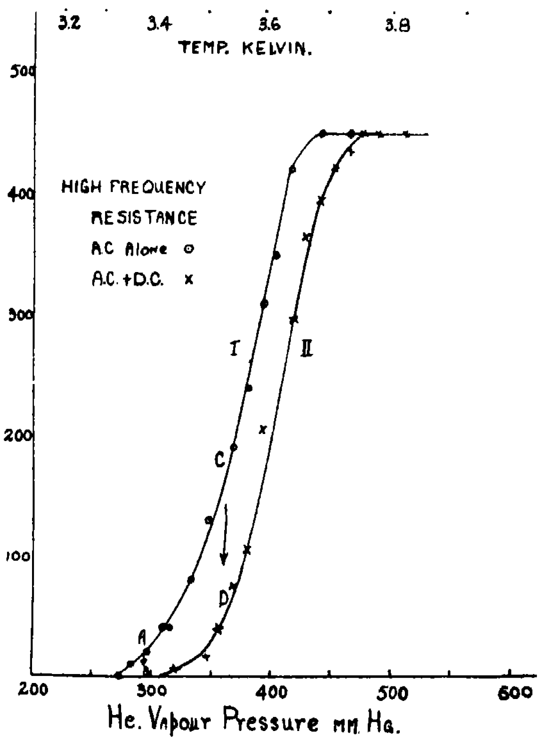

FIG. 4.

Electron Lattice Theory

Interest in the problem of supra-conduction in metals has been stimulated recently by a view put forward independently by Prof. Niels Bohr, of Copenhagen, and by Prof. R. de L. Kronig, of Groningen, in communications to McLennan. The essential feature of this view is that the conducting electrons in a metal are supposed to form a crystal lattice of their own in addition to that formed by the atom-ions of the metal.

According to quantum mechanics, it appears that this electron lattice can move through the wire lattice without dissipation of energy even when the wire lattice is in thermal agitation. In other words, the metal will be supra-conducting whenever the electron lattice exists.

On this view of supra-conductivity, the transition point or temperature at which the metal passes from the supra-conductive state to the ordinary conducting one may be interpreted as the melting point of the electron lattice. The view that the conducting electrons in metals may build a lattice has already been put forward by Prof. F. A. Lindemann[7] and the suggestion was made both by him and by Sir J. J. Thomson that this idea may provide a basis for an explanation of the phenomenon of supra-conduction in metals. Without the aid of quantum mechanics, however, it was not clear that an electron lattice of the type now invoked could be stable and could be given a translatory motion without dissipation of energy through the wire lattice of a metal endowed with thermal agitation.

The electron lattice theory is a promising one, for it affords a direct and ready explanation of a number of the phenomena associated with supra-conduction in metals. The final verification of the theory will probably be reached through a study of the conductivity of single crystals of metals at the lowest temperatures. As de Haas has indicated, investigations have been begun already in this direction.

[1] *Phil. Mag.*, 5, **36**, 271; 1893.

[2] For example, Sir J. J. Thomson, *Phil. Mag.*, 6, **30**, 192; 1915; and Richardson, *Phil. Mag.*, 6, **30**, 295; 1915. Ashworth, *Phil. Mag.*, 6, **27**, 357; 1914; and *Phil. Mag.*, 6, **36**, 351; 1918.

[3] Errera, *J. Phys.*, 6, **5**, 304; 1924; J. Granier, C.R. Acad. Sci., **179**, 1,314; 1924; Debye and Wentsch, see "Polar Molecules", by Debye, p. 102, pars. 20 *et seq.*

[4] McLennan, McLeod and Wilhelm, *Trans. Roy. Soc. Canada*, 3, **23**, Sect. III, 269; 1929.

[5] McLennan, Hunter and McLeod, *Trans. Roy. Soc. Canada*, 3, **24**, Sect. III, p. 3; 1930; McLennan, Burton, Pitt and Wilhelm (Footnote), *Phil. Mag.*, 7, **12**, 708; 1931; McLennan, Smith and Wilhelm, *Phil. Mag.*, 7, **12**, 835; 1931.

[6] McLennan, Burton, Pitt and Wilhelm, *Phil. Mag.*, 7, **12**, 707; 1931; *Trans. Roy. Soc. Canada*, 3, **24**, Sect. III, 191; 1931; NATURE, **128**, 1004; 1931; and *Proc. Roy. Soc.*, A, **136**, 52; 1932. *Proc. Roy. Soc.*, A, **138**, 245; 1932.

[7] *Phil. Mag.*, 6, **29**, 127; 1915.

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work on the taxonomy of Hymenomycetes. Mycological classification is emerging from a state of chaos, and the student or amateur will be able to orientate much knowledge which formerly puzzled him. The address is published in the *Transactions* of the Society (vol. 17, pp. 16–34, 1932) and will serve as a valuable guide to the most important literature on the subject.

Physical Society's Exhibition

THE twenty-third annual exhibition of scientific instruments and apparatus, arranged by the Physical Society, will be held on January 3–5 at the Imperial College of Science and Technology, South Kensington, S.W.7. It will be open in the afternoons from 3 P.M. until 6 P.M. and again in the evenings from 7 P.M. until 10 P.M. The leading manufacturers of scientific instruments will be exhibiting their latest products in the Trade Section. The Research and Experimental Section will contain contributions from most of the important research laboratories in Great Britain, and there will be a special sub-section devoted to experiments of educational interest. In addition, the work submitted for the craftsmanship competition by apprentices and learners will be on view. Discourses will be delivered each day at 8 P.M. as follows: January 3, Dr. Allan Ferguson: "Surface Tension and its Measurement"; January 4, Mr. R. A. Watson Watt: "Cathode Ray Oscillography"; January 5, Mr. F. Hope-Jones: "Time Measurement: Old and New". Members of institutions and scientific societies may obtain tickets from their secretaries; tickets may also be obtained from the Exhibition Secretary, 1, Lowther Gardens, Exhibition Road, S.W.7. Admission on January 5 will be free, without ticket.

Announcements

THE Buchan prize of the Royal Meteorological Society for 1933 has been awarded to Mr. David Brunt, for papers contributed to the *Quarterly Journal* and *Memoirs* of the Society during the years 1927–31.

PROF. G. ELLIOT SMITH, professor of anatomy in University College, London, has been appointed Fullerian professor of physiology at the Royal Institution to succeed Prof. J. B. S. Haldane, whose tenure of office expires next January.

THE Lawrence research studentship of the Royal Society has been awarded to Miss P. A. Clapham, who proposes to work at the London School of Hygiene and Tropical Medicine on helminthic infestation and nutritional deficiency.

A DISCUSSION on "The Chemistry of the Sterols and Bile Acids", to be opened by Prof. I. M. Heilbron, H. Harrison professor of organic chemistry in the University of Liverpool, will be held at the Chemical Society on Thursday, December 15, at 8 P.M.

DR. ULICK R. EVANS has been elected to the research fellowship in metallurgy of the Armourers and Brasiers' Company, in succession to Dr. W. Hume-Rothery. The award is made by a joint committee of the Royal Society and the Armourers and Brasiers' Company.

MR. COLIN HARDIE, fellow and classical tutor of Balliol College, Oxford, has been appointed to succeed Mr. Arthur Hamilton Smith as director of the British School at Rome as from January 31, 1933.

SIR HENRY DALE, director of the National Institute for Medical Research, will deliver the Harrison memorial lecture of the Pharmaceutical Society of Great Britain on December 13. The title of Sir Henry's lecture will be "Therapeutic Problems of the Future". At the conclusion of the lecture, the Harrison Medal will be presented to Sir Henry Dale.

To commemorate the bicentenary of the birth of Sir Richard Arkwright, inventor of the yarn spinning frame, the Newcomen Society has arranged for a public lecture to be delivered on December 14, at 5.30. The lecture will be given at the Science Museum, South Kensington, London, S.W.7, by Mr. Frank Nasmith.

MR. A. ABBOTT, formerly chief inspector for technical education at the Board of Education, has been awarded the Institute Medal of the Textile Institute. Mr. Abbott was formerly assistant secretary to the Department of Scientific and Industrial Research and did much work in connexion with the establishment of the Cotton Research Association.

THE twentieth annual meeting of the Indian Science Congress will be held at Patna on January 2–7 under the presidency of Dr. L. L. Fermor, director of the Geological Survey of India. The Congress will meet in nine sections, namely, agriculture, mathematics and physics, chemistry, zoology, botany, geology, medical and veterinary research, anthropology and psychology. The local secretaries are Dr. K. S. Caldwell and Prof. Kamta Prashad, both of the Science College, Patna.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant teacher of engineering science, handicraft and drawing at the Radcliffe Technical College—The Secretary of Education, Town Hall, Radcliffe, near Manchester (Dec. 14). An executive engineer and an assistant engineer (mechanical) to the Government of Madras for harbour works at Cochin—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Dec. 23). A public analyst to the City of St. Albans—The Town Clerk, Municipal Offices, St. Albans (Dec. 31). A principal at the Handsworth Technical College—The Chief Education Officer, Education Office, Margaret Street, Birmingham (Dec. 31). A University reader in psychology at Bedford College, London—The Academic Registrar, University of London, S.W.7 (Jan. 26). A University reader in physiology at Guy's Hospital Medical School—The Academic Registrar, University of London, S.W.7 (Feb. 17).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Hexuronic Acid as the Antiscorbutic Factor

A CHARACTERISTIC property of Prof. Szent-Györgyi's hexuronic acid is its behaviour towards iodine. Two atoms of iodine are taken up in aqueous solution (neutral or acid) with formation of two molecules of hydrogen iodide. We find that this is due to oxidation at a double bond. The intervention of water is essential and the product, which is not a di-iodide, can be reduced to hexuronic acid. Regeneration of hexuronic acid occurs only when the aqueous solution of the oxidation product is reduced, for example, by evaporation in the presence of hydrogen iodide.

The biological activity of the acid is probably due to this double function of oxidation and reduction which, unique among purely carbon compounds, is reminiscent of the behaviour of glutathione. The product obtained by the action of neutral iodine on the acid undergoes further oxidation by sodium hypoiodite. One atomic proportion of oxygen is absorbed, two new carboxylic acid groups are formed and oxalic acid (1 mol.) is produced quantitatively. Acid permanganate introduces one atom of oxygen into hexuronic acid with extreme readiness and thereafter oxidation proceeds more slowly with elimination of carbon dioxide until three atoms of oxygen have been absorbed. This leads to the formation of a trihydroxy butyric acid (possibly *d*-threonic) which has been isolated as the optically active crystalline amide $CH_2OMe.CHOMe.CHOMe.CONH_2$. When heated with hydrochloric acid hexuronic acid gives furfural in quantitative yield. These observations suggest that hexuronic acid (which, from analysis of its salts we have proved to be a monobasic acid $C_5H_7O_4.COOH$ and not a lactone of an acid $C_5H_9O_5.COOH$) has the structure $COOH.CO.CO.CH_2.CHOH.CH_2OH$.

The following observations which we have made are consistent with this view. Hexuronic acid forms a di-phenyl-hydrazone $C_6H_8O_4(:N.NHPh)_2$, also a hydrated di-(*p*-bromo-phenylhydrazone), and reacts slowly at 15° with *o*-toluylene diamine giving a well-defined condensation product. The sodium or calcium salt of hexuronic acid gives an intense violet colour with ferric chloride but with the free acid the coloration is fleeting. The sodium salt gives with sodium nitroprusside a deep blue colour, changing to green and then red. The acid and its salts show an intense absorption band with head at about 265 mμ.

Hexuronic acid contains one carboxyl and three potential hydroxyl groups (alcoholic or enolic) and gives a triacetate and a trimethyl ether which both reduce neutral permanganate. When heated at about 175° the acid loses carbon dioxide without darkening or melting (when heated rapidly the pure acid melts at 192°). Whilst the acid has $[\alpha]_{5780}$ + 24° in water the sodium salt has a much higher rotation, +105° in neutral solution, +135° in *N*/10 alkali, (keto-enol transformation). Hexuronic acid appears to be incapable of forming a lactone and its solutions do not display mutarotation. The slow change ($[\alpha]_{5780}$ + 24° → 31°) which occurs with aqueous solutions in glass vessels is due to partial neutralisation of the acid by alkali dissolved from the glass. Alkaline solutions of the acid are stable in the absence of oxygen.

These observations indicate the presence of an optically active diketo-acid containing a $-CH_2-$ group. These groups must be united in such a way that the stringent requirements of the crystallographic and X-ray data are satisfied. It is essential, for example, that the carbon and oxygen atoms (with one exception) should lie in a plane and that the length and breadth of the molecule should be 8·8 and 6·1 A. respectively. A critical survey of various possibilities from the chemical, optical and X-ray data has led us to the conclusion that the properties of hexuronic acid are best accounted for by the above structure. This can react also in the enolic modification, $CO_2H.CO.C(OH)=CH.CHOH.CH_2OH$.

We have examined (with R. W. Herbert) the absorption spectrum of de-citrated lemon juice and have estimated that the hexuronic acid content corresponds with the recorded evaluation of the antiscorbutic activity of isolated hexuronic acid.

E. G. COX.
E. L. HIRST.
R. J. W. REYNOLDS.

Chemistry Department,
The University,
Edgbaston, Birmingham.
Nov. 22.

A Peculiar Visual Experience

WHILE I was engaged in flashlight colour photography, using large charges of magnesium and the ordinary touch-paper method of ignition, the fuse on one occasion apparently failed to act, but, just as I was about to replace it, the flash took place. My head was less than a foot above the explosion point, and the flame must have reached my face, as my eyebrows and hair were singed, and my spectacles were completely coated with a dense, firmly adherent film of magnesium oxide.

My subsequent visual sensations were as follows: for an indeterminate period, which, after making generous allowance for subjective impressions, I would estimate at about twenty seconds, there was a complete 'black-out'. After this period (during which I removed my glasses and rubbed my eyes) I observed the filament of a 100 watt gas-filled lamp, about three feet distant and screened by a thin orange silk shade, which appeared as a bright red line. In about twenty seconds more (this and subsequent times were taken with a watch) I could distinguish general details of the furniture of the room, which was fairly well lighted, in red monochrome. The colour changed from deep maroon to light claret in about fifteen seconds, and then to an orange shade in about ten seconds more, but a prominent red object retained its normal shade. Then the background and white objects changed suddenly—too quickly for the time to be observed—to a green, at first olive, afterwards brightening to emerald. This stage lasted nearly twenty seconds, and it was noted that the red and orange objects appeared in their natural colours. The green shade then faded away rapidly, and the whites, after a slight intermediate yellow tinge, appeared for the first time. The total illumination appeared to

increase steadily over the whole period of about ninety seconds; examination of the pupils showed that they were still abnormally contracted at least two minutes after the flash took place. Owing to nervous reaction, I am unable to state whether further after-images or colour changes occurred.

I presume that the flash had reached its maximum intensity before the pupil or eyelid reflex could operate, and that the eye was exposed to a very powerful beam of strongly actinic light. The peculiarity was that colour sensation was regained discontinuously, and not in the spectral order that might have been expected. The failure to observe any blue phase in the after images, as described by Washburn[1] and McDougall[2] in their experiments where the eye was exposed to white light of moderate intensity, is readily explicable; but the change in the red shade and the sharp succession of the green, followed by the yellow, is much more difficult to comprehend. I should be interested to know if it can be satisfactorily explained on the existing theories of colour vision, and whether other experiences of similar causation and result have been observed.

University College, Gower Street, London, W.C.1. K. MACKENZIE.
Nov. 7.

[1] M. F. Washburn, *Psychol. Rev.*, 7, 39; 1900.
[2] W. McDougall, *Mind*, 10, 235; 1901.

Records of Pelagic Animals in Scottish Waters

IN their interesting letter to NATURE (Oct. 29), Dr. Stanley Kemp and Dr. F. S. Russell refer to the abnormal distribution of certain pelagic animals during the current year as pointing to unusual hydrographic conditions. In Scottish waters also, conditions seem to have been somewhat disturbed, judging by the occurrence of certain other animals.

Whales and dolphins appear to have been specially plentiful if the record of stranded specimens bears any relation to the actual numbers present in the adjacent sea. Already this year ten specimens have been reported,[1] while in 1931, 1930 and 1929 the numbers were four, none, and three respectively. The most interesting was a young white whale, *Delphinapterus leucas*, a rare arctic visitor, taken in the Firth of Forth.

Early in November, also, a long-finned tunny (*Thynnus germo*) was taken at Lochgoilhead in the Firth of Clyde. (Full details will appear in the next number of the *Scottish Naturalist*.) Apparently, this is only the second record of this southern species in Scottish waters.

The Royal Scottish Museum, Edinburgh, 1. A. C. STEPHEN.
Nov. 11.

[1] *Scot. Nat.*, p. 163, 1932.

Fixation of Mitochondria

IT has been known for many years that Carnoy, Gilson, Petrunkevitch, corrosive acetic, Bouin, and a host of ordinary fixatives will enable remains of mitochondria to be demonstrated with staining in alum hæmatoxylin or acid fuschsin. This applies especially to cytoplasmic inclusions when aggregated as in the spermatogonium, or in the mitochondrial *nebenkerne*. Mitochondria often show nicely after acetic acid containing fixatives such as the 'Susa' mixture or Flemming with acetic acid. This applies especially to all vertebrate tissues. With most invertebrate tissues such methods are deadly, and if mitochondria remain they are almost certainly badly distorted. Practically all the beautiful work of Meves was done with acetic acid containing fixatives. This is why he left so much to be done by those who followed.

Bouin's fluid contains formalin, which often enables surprisingly good results to be obtained with this fixative, and in the case of bulky insect or other testes, the concentration of acetic acid in this fixative becomes lessened as the innermost parts of the tissue are reached. In any event, the objection to acetic acid is that if it does not dissolve much of the cytoplasmic bodies, it distorts them badly ("Vademecum" § 697). Scorpion spermatocyte mitochondria are completely wrecked by Flemming with acetic and only occasionally properly 'set up' for passage through the alcohols and xylol, by using Flemming without acetic. Post-chroming for such objects is very necessary ("Vademecum" § 710). In some cases for staining, the post-chroming may be delayed until the sections are actually in the slide. This was done in the case of Duesberg's beautiful paper on the relationship between the organ-forming substances and the cytoplasmic inclusions in the ascidian egg. It might be possible, as Dr. John Baker has suggested[1], to develop the technique of post-chroming Bouin (without acetic) material so as to get material up to a research standard ("Vademecum" § 710). The advantage of this is that formalin and picric acid are cheap and easily transported, whereas the osmic and silver methods are tricky. Some years ago, I got a number of *Lepidosiren* sent over from the Chaco in a tin of Bouin without acetic. The fixation was splendid but there was no spermatogenesis in progress. The fluid had eaten the tin only slightly, and the discoloration of the Bouin, when the tin was opened, did not appear to have damaged the fishes. In the case of these *Lepidosiren*, post-chroming did not improve the staining of the mitochondria, nor did it bring out the Golgi bodies. For these the proper methods are the only satisfactory ones.

Trinity College, Dublin. J. BRONTË GATENBY.
Nov. 16.

[1] NATURE, 130, 741, Nov. 12, 1932.

Hybridism in Eels

IN New Zealand there are two species of eel recognised by J. Schmidt.[1] These are the short-finned eel, *Anguilla australis*, and the long-finned eel, *Anguilla aucklandii*. Latterly I have shown that *Anguilla aucklandii* must become *Anguilla dieffenbachii* on the grounds of priority.[2] Sexes of eels keep apart in our fresh water and in the migration seawards of eels in the autumn this segregation of the species is usually most marked. The male in both species is small, while females are much larger, the last to migrate seawards being the large female *A. dieffenbachii*, which generally measure more than 5 ft.

Schmidt has noted that in *australis* the vomerine band of teeth is pear-shaped, and in *dieffenbachii* this band tapers well back on the roof of the mouth as far as the maxillary band. Another feature noted also by Schmidt is the fact that the angle of the mouth in *dieffenbachii* extends back beyond the eye whereas in *australis* this angle is stated to be approximately below the hind margin of the eye. Larval *dieffenbachii* sent to me some years ago from Mataura

Falls, Otago, have the angle of the mouth reaching only to under the centre of the eye. As this is the large-mouthed species of eel, it is possible that we have here a hybrid with the mouth of *australis* and the fins of *dieffenbachii*.

In April 1932, I had the opportunity of visiting Lake Ferry, Wellington, through which many eels run in the seaward migration. Among a number of male long-finned eels, I found a female of the short-finned species which was caught with them. This example is 35·7 in. long, and has the fins and small mouth as in *A. australis*; but the teeth are as in *A. dieffenbachii*. The vomerine band is widest about the centre and tapers well backwards reaching nearly as far back as the maxillary bands. While this tapering band of teeth does not reach quite so far back as it should to be exactly true to *dieffenbachii*, it is certainly not pear-shaped and is close enough to that species in this important respect. I can only conclude that the eel which I have mentioned is a hybrid between our two common species, thus shedding new light on the species problem of *Anguilla* throughout the world.

Dominion Museum, Wellington, New Zealand. W. J. PHILLIPPS.

[1] *Trans. N.Z. Inst.*, 58, 379–388; 1928.
[2] *N. Z. J. Sci. and Tech.*, 13, No. 4, 228; 1932.

Priapulus caudatus in New Zealand Waters

THE antarctic variety of this northern species of *Priapulus*, whether it be called *tubercule-spinatus* Baird or *antarcticus* Michaelsen, is confined, according to recent authorities, to the most southern seas; for example, off Tierra del Fuego, Patagonia, South Georgia, Falkland Is., Graham area, Cape Adare, Kerguelen.

Early in this year I received from Mr. A. B. W. Powell, the conchologist at the Auckland Museum, a collection of polychætes dredged in the harbour at that city, and in one of the phials I found to my intense surprise a small specimen of *Priapulus* measuring about one inch in length. It is well preserved and exhibits the characteristic arrangement of the spines or teeth described by Theel and so beautifully figured by his artist. It was obtained at a depth of 8 fathoms in Islington Bay, Auckland Harbour, associated with *Terebellides stroemi*, *Lanice conchilega*, and *Lagis australis*; the bottom was of black gritty mud.

As the variety has never been recorded from so far north it seems worthy of record in NATURE.

University Museum, Dunedin, N.Z. WM. B. BENHAM.
Oct. 12.

Chemical Composition of the Animal Body

IT is customary to express the results of an ultimate analysis as mass percentages, thus: oxygen, 65 per cent; carbon, 18·25 per cent; hydrogen, 10 per cent, and so on. But, on modern views, the chemical activities of these elements do not depend on the nuclear masses of the atoms but on their outer valency electrons. Therefore the chemical composition of, say, clupein (the protamine of the testis of the herring) is best expressed as $C_{30}H_{57}N_{17}O_{6}$, or by some such empirical formula. When the results are stated in this way it appears that the order of abundance of the chemical elements in an animal body *is directly proportional to their atomic numbers, so that the characteristic organic element is hydrogen*.

Some interesting speculations are suggested whenever one studies a recent statement of the Periodic Law with this relation in mind. Unfortunately there is no really good complete ultimate chemical analysis of the whole body of any one animal in the literature of physiology, and so it is impossible to be sure as to the order of abundance of oxygen and nitrogen, and of the elements sodium, potassium, etc., in the results. The empirical formulæ of most of the substances composing the tissues are known but it is difficult to 'weight' these numbers according to the proportions of the tissues in the whole body. Perhaps, also, the water in the tissues is really an organic constituent in the same sense as carbon is such a constituent. Is the order of abundance of the mass numbers of the isotopes of oxygen and nitrogen known in cases where these elements have been isolated from living organisms? Other questions immediately occur to one and it is plain that here there is something to be investigated.

JAS. JOHNSTONE.
University of Liverpool.
Nov. 19.

Magnetic Rotatory Dispersion and Absorption of the Cerous Ion in Solution

BECQUEREL and de Haas,[1] from their work on the magnetic rotation of the crystal tysonite, predicted that the Ce^{+++} ion possesses an intense paramagnetically active absorption band in the neighbourhood of λ 2370 A. This prediction was based on the assumptions that (1), although tysonite is a complex fluoride of Ce^{+++}, Pr^{+++} and Nd^{+++}, the only sensibly rotating ion is Ce^{+++}; (2) the rotation due to Ce^{+++} is controlled by a single absorption frequency. It occurred to us that it would be of interest to test the validity of this predicted property of the Ce^{+++} ion, by investigating the magnetic rotation of solutions of cerous salts in the visible and near ultra-violet regions of the spectrum.

By means of the polarimetric method of Bruhat and Pauthenier[2] (without using double monochromator) we have investigated at room temperature the magnetic rotation of three solutions of cerous sulphate in water, of strengths approximately 0·7, 2·7 and 4·4 per cent, for the mercury lines 5780, 5461, 4358, 4046, 3652, 3341 and 3128A. Our results for the dispersion of the specific magnetic rotation of cerous sulphate indicate the existence of two paramagnetically active absorption bands; a weak one in the neighbourhood of 300 mμ and a strong one in the neighbourhood of 240mμ. Our results are not sufficiently precise to determine with accuracy the wave-lengths of both these active bands; recourse must be made to absorption data.

Recently, the absorption of the Ce^{+++} ion in solution has been investigated by Bose and Datta,[3] who find in solutions of cerium trichloride in water a weak band at 2960A. and a strong band at 2550A. If we assume in our calculations the wave-length of the weak active band to be 296mμ, we find the value 239mμ for the effective wave-length of the strong band. It must be pointed out that this absorption band alone, although having a wave-length in close agreement with that obtained by Becquerel and de Haas, will not account for the ultra-violet dispersion of cerous sulphate as determined by us.

In comparison with the value 255mμ given by Bose and Datta for the position of the strong absorption band, the value 239mμ seems to indicate the presence of other absorption bands of the Ce^{+++} ion

having shorter wave-lengths than 255mμ. At our request, Dr. R. A. Morton kindly investigated the absorption spectrum of a solution of cerous sulphate in water. In addition to bands occurring at 296mμ and 254mμ, he found strong bands at 240mμ and 223mμ. As our value 239mμ is to be regarded only as an effective wave-length, and as, according to the absorption measurements, the intensities of the bands 254mμ, 240mμ and 223mμ are of the same order of magnitude, it would appear probable that all these bands are active. It must be mentioned that absorption bands with roughly these wave-lengths have already been found by Freed[4] in a mixed crystal of lanthanum and cerium ethyl sulphate.

In our calculations, we have neglected the dispersion due to the sulphate ion. As the characteristic frequency of this ion is very high compared with the frequencies considered, we should expect the contribution of this ion to the magnetic rotation to be very small. By means of further experiments we hope to be able to estimate the effect due to the sulphate ion.

R. W. ROBERTS.
L. A. WALLACE.

George Holt Physics Laboratory,
University of Liverpool.
Nov. 2.

[1] *Z. Phys.*, **57**, 11; 1929.
[2] *Rev. d'Opt.*, **6**, 163; 1927.
[3] NATURE, **128**, 270, Aug. 15, 1931.
[4] *Phys. Rev.*, **38**, 2122; 1931.

Gyromagnetic Effect in Some Ferromagnetic Powders

BOTH the gyromagnetic effects, namely, the production of (1) magnetisation by rotation, and of (2) rotation by magnetisation, have been applied to deduce the ratio of angular momentum to magnetic moment of the elementary magnet in ferromagnetics. The theoretical value of this ratio R for an orbital electron is $2m/e$ and for a spinning electron m/e. Results of observations on all ferromagnetics by the method of rotation by magnetisation gave values[1] of R exactly equal to m/e within very narrow limits of experimental error, which is less than one per cent for the metallic rods, and about five per cent for the powders investigated. Making use of the first effect, Barnett[2] found for the ferromagnetic metals values of R which, according to his estimate, are several per cent higher than the orthodox value for the spinning electron. This may mean that the orbital moment is also partly effective in producing ferromagnetism.

At the suggestion of Prof. D. M. Bose, I undertook in his laboratory the gyromagnetic study of a number of substances, among them some ferromagnetic powders. The method employed was the resonance method of Einstein and de Haas, and the apparatus was very similar to that used by Sucksmith.[3] The material was packed in a thin glass tube of length about 6 cm. and of diameter varying from 1·3 mm. to 2·3 mm.; the field applied was about 230 gauss and the vacuum method was employed to get increased resonance amplitude, which for the thinner tubes was about 3 cm. at a scale distance of 130 cm. The following results have been obtained:

	R
Fe_3O_4 (precipitated)	1·008 m/e
Fe_2O_3 (ferromagnetic)	1·016 m/e
NiO, Fe_2O_3	1·022 m/e

The error in all probability does not exceed two per cent, so that for these substances, as for the others investigated by the same method (that is, rotation by magnetisation), the value of R realised is the exact value for the spinning electron.

D. P. RAY-CHANDHURI.

Ghose Physical Laboratory,
University College of Science,
Calcutta. Oct. 12.

[1] An excellent summary of the methods and results is given by S. J. Barnett in the "International Critical Tables", vol. 6, p. 345, 1929.
[2] S. J. Barnett, *Proc. Amer. Acad.*, **66**, 273; 1931.
[3] W. Sucksmith, *Proc. Roy. Soc.*, A, **128**, 276; 1930.

Anthropology of Veddahs

IT may interest many readers of NATURE to hear of the results of my recent expedition into the Veddah territory in the interior of this island. The expedition took place on September 18–25 of this year. The part visited was the Nilgala division of the Uva Province, where probably the best Veddahs in Ceylon still live. The track lay through the Sinhalese villages of Hamapola, Pitakumbura and Bulupitiya. In some of these the inhabitants betrayed very obvious traces of Veddah admixture. From the last-named place the track led on to the Veddah settlement of Dhanigala. Practically all the Veddahs of this area were collected together and photographed, whilst all the males were measured anthropometrically. The one-time chief of this group, Tuta, whose photograph is given in Seligmann's "The Veddas" had died some time previously. His grave was pointed out to me and I personally removed the skeleton. It was not in a very good state of preservation, but the skull, at any rate, was removed without appreciable damage to the very fragile facial portion.

After spending a night here the expedition was carried on over a range of hills to another Veddah settlement at Henebedda. The living Veddahs were examined and measured as before, and in addition I was fortunate in securing two very complete skeletons. One, a male, belonged to Poromala, probably the one pictured in Seligmann's book. This was comparatively recent, and in perfect preservation. The other was that of a young female named Handhi, who, judging from her skeleton, had suffered severely from yaws. This had caused some atrophy of the bones of the left upper limb, and had left large spindle-shaped swellings on both tibiæ. Apart from these points the skeleton is in very good preservation, and compares favourably with the others.

All the skeletons agree in certain important points that are probably characteristic of the race. In the two males the tibiæ are markedly platycnemic. The pathological condition in the female skeleton precludes a judgment on this point. In only one humerus (in the old man, Tuta) was there a perforated olecranon fossa. This is contrary to the Sarasins' statement that it was common in Veddahs. As a matter of fact, one finds the condition in almost every Sinhalese and in many Tamil humeri, so that it is of little diagnostic importance. All the skulls agree well in general character with one another and with certain others labelled as Veddahs which have been loaned to me by the Colombo Museum through the kindness of the Director. It is interesting to note that two of these three skeletons present each an unusual anomaly. The female skeleton has a marked sacralisation of the last lumbar vertebra, associated with complete absence of the last pair of ribs. The skeleton of Poromala presents a complete degree of non-union of the neural arches in the sacral vertebræ.

It is proposed to publish a preliminary report on the three skeletons in the *Ceylon Journal of Science*. Detailed consideration will be left until a more complete study has been made, and opportunity for comparison with other reputed Veddah material in the various museums in Europe has been taken. It is also hoped that further new material will shortly be forthcoming from the Bintenne and Tammankaduwa districts of the Veddah country.

I may add that a complete collection of hair from various parts of the body in both sexes and at several ages was taken from the Dhanigala Veddahs. This will be studied and compared with the hairs of other Ceylon races. Further hairs were obtained from graves of Poromala and Handhi. I should be delighted to exchange samples of this for hair of other races with any anthropologist in possession of such material.

Anatomy Department, W. C. OSMAN HILL.
Medical College,
Colombo, Ceylon.
Oct. 27.

Dimensions of Fundamental Units

PROF. W. CRAMP has suggested[1] that the quantities Q, L and T have better claim to be regarded as fundamental than M, L and T. His argument is based on the assumption that Q shall be a function of M. Such an assumption would be a bombshell in modern physics. M, in common with L and T, is a quantity which varies with the velocity of the observer; Q does not so vary.

The wiping out of all fractional indices from the dimensional expressions for the electrical quantities, current, flux, E.M.F., etc., by leaving Q in those expressions is scarcely noteworthy. Fractional indices come into the dimensional expressions for electrical quantities at the outset when, by writing $(Q \times Q/kL) = F = MLT^{-2}$ we find $Q = k^{\frac{1}{2}}M^{\frac{1}{2}}LT^{-1}$. If Q were left in, no fractional indices would appear and also no k; and since, if we neglect both k and μ the ratio of the electromagnetic units to the electrostatic units is always a velocity, or a velocity squared, or the reciprocal of one of these—that is to say, contains no fractional indices—it follows that the presence of Q wipes out fractional indices from dimensional expressions in both the electromagnetic and the electrostatic systems.

F. M. DENTON.
Department of Electrical Engineering,
University of New Mexico,
Albuquerque.
Oct. 19.

[1] NATURE, 130, 368, Sept. 3, 1932.

MY old student, Prof. F. M. Denton, has, I know, given a good deal of attention to the theory of relativity, and this no doubt has led him to question the possibility of any dimensional relationship between M and Q. While not pretending to have the same knowledge of Einstein's theory, it does seem to me that there is little experimental evidence for the assumption that M varies with the velocity of the observer while Q does not. It would be interesting to know upon what grounds Prof. Denton makes so positive a statement.

The University, WILLIAM CRAMP.
Birmingham.
Nov. 8.

Recalculation of Mass Defects

THE well-known mass defect curve of the old nuclear scheme calculated with regard to α-particles and protons presented a difficulty with its minimum of binding energy for tin and an increasing portion between tin and lead. On the other hand, the mass defect values against protons give a rather smoothly decreasing curve.[1] As has already been pointed out,[2] the number of α-particles must be considerably reduced from the point of view of the new scheme, which does not admit any electrons in nuclei, but only neutrons and protons (presumably joined as α-particles). The curve of mass defect against protons and neutrons (perhaps with a single 'central' α-particle) is very similar to the old curve against

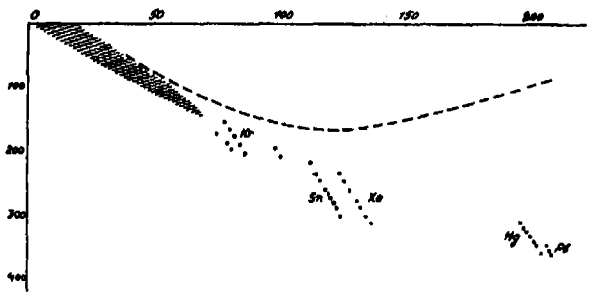

FIG. 1.

protons, but decreases less rapidly. Clearly the new mass defect values relatively to α-particles, neutrons and protons must lie somewhere between the old values computed relative to protons and α-particles respectively (because the number of α-particles is decreased). We may emphasise that this new mass defect curve shows no increasing portion between tin and lead. For illustration we give two typical values:

Old: $50Sn^{124} = 31\alpha + 12\varepsilon$; mass defect $= 0 \cdot 158$ (in mass units);
$82Pb^{208} = 52\alpha + 22\varepsilon$; mass defect $= 0 \cdot 035$.
New: $50Sn^{124} = 25\alpha + 24\omega$ (ω = neutron); mass defect $= 0 \cdot 304$;
$82Pb^{208} = 41\alpha + 44\omega$; mass defect $= 0 \cdot 366$.

On the accompanying graph (Fig. 1) are plotted the new mass defect values; the dotted line shows the old smoothed curve.

The significant result mentioned above depends not on the doubtful decimals in the value of neutronic mass but only on the fact that the number of α-particles is diminished in comparison with the number usually admitted, some being split to neutralise the 'nuclear electrons'.

Phys. Tech. Institute, D. IWANENKO.
Leningrad-Lesnoi.
Oct. 19.

[1] F. Houtermans' article on the constitution of nuclei in *Ergebnisse d. exakten Naturwiss*, *Bd.* 9, p. 124.
[2] D. Iwanenko, *Sow. Phys.*, 1, 820; 1932.

Process of Space Quantisation

THE following note is a report of researches into the process of space quantisation, carried out during the last two years in the Institute of Physical Chemistry in Hamburg.

The problem may be stated as follows. When a ray of potassium atoms is sent through an inhomogeneous magnetic field, it is split into two rays (space quantisation). If one of the rays is then screened out, all atoms in the remaining ray have the same

axial direction (that is, the same component of magnetic moment in the direction of the field). The ray is then sent through a homogeneous magnetic field, the direction of which is changing with time (for example, a rotating field). After the ray has passed this rotating field, it goes through a second inhomogeneous field. This last field serves to determine whether all the atoms still have the same orientation (in which case they would be deviated towards the same side) or whether some of them have been re-oriented (*umgeklappt*).

The proportion of re-oriented atoms to those having the original orientation depends upon the ratio of the Larmor period, T_l, to the period of rotation of the field, T_f. If T_f is large compared with T_l, that is, if the atom completes many Larmor precessions during the interval required for an appreciable change of field direction—then the process is an adiabatic one and no re-orientation occurs. If an appreciable fraction of the atoms is to be re-oriented, T_f and T_l must be of the same order of magnitude.

Under usual experimental conditions, $T_f >> T_l$; that is to say, the adiabatic case is realised, and no re-oriented atoms are observed. In order that the non-adiabatic case may be realised, the Larmor period T_l must be made as large as possible (that is, very weak fields must be employed), and T_f must be as small as possible. We have succeeded in producing these non-adiabatic conditions in the following manner. The ray passed through a region enclosed in an iron shield where there existed a very weak magnetic field, constant in space and in time. Its strength was a few tenths of a gauss. The variation of the field with time was brought about by causing the ray in its course through the shielded region to pass close to a wire. Atomic ray, wire, and lines of force were at right angles to one another. When a current flowed through the wire, its magnetic field was superposed upon the constant field inside the iron shield. In this way the field was made inhomogeneous in space, and atoms which passed near the wire experienced a change of field direction from point to point; this was equivalent to a variation of the field with time.

We found that with weak currents through the wire (that is, with no appreciable rotation of the field) there were no re-oriented atoms—just as was the case with a strong field (the adiabatic case). But when the constant field was only a few tenths of a gauss, and when the current in the wire was so adjusted that the field of the wire in the region where it was traversed by the ray was also of this order of magnitude, a noticeable part of the atoms (as much as one-third) was re-oriented. The number of re-oriented atoms, and the dependence of this number upon (1) the current in the wire, (2) the distance of the ray from the wire, and (3) the velocity of the atoms, agreed with the theoretical prediction.[1]

R. FRISCH.
T. E. PHIPPS.
E. SEGRÈ.
Hamburg, Aug. 15. O. STERN.

[1] P. Güttinger, *Z. Phys.*, **78**, 169; 1932; and E. Majorana, *Nuovo Cim.*, Nr. 2, 1932; where the theory is still better adapted to our experimental conditions.

Fundamental Frequencies of the Group SiO_4 in Quartz Crystals

THE particular properties of quartz crystals (SiO_2), as compared to those of carbon dioxide (CO_2) have led Sir William Bragg to the conception of considering a quartz crystal as one single molecule.

An analogous constitution is shown by the polymeric homologue series of silica esters, the Raman spectra of which I have recently investigated.[1] It has been observed that in these compounds four characteristic scattered frequencies must be attributed to the group SiO_4. Of these frequencies two are independent of the degree of polymerisation, while the other two show a continuous shift with the degree of polymerisation. The line 642 cm.$^{-1}$ of the monomeric ester which is shifted so far as 518 cm.$^{-1}$ is a conspicuous example of the last mentioned behaviour. The latter corresponds to a line of the decameric ester.

Making use of the above mentioned results, the fundamental frequencies of the SiO_4 group in quartz can be located. The results are seen from the following table.

	ν_1	ν_2	ν_3	ν_4
ν cm.$^{-1}$	502	800	1062-1086	1170-1208
$\lambda\mu$	19·92	12·5	$9{\cdot}4_1$-$9{\cdot}2_1$	8·54-8·28

With the aid of these four fundamental frequencies, the entire ultra-red spectrum of quartz below 10μ can be interpreted as a system of combination bands of the second to the fourth order. Attempts to determine the fundamental frequencies and to arrive at a system of combination bands have been made by Plyler[2] and Parlin.[3] The frequencies assumed by them differ partly from those arrived at above and consequently the values of the frequencies of the combination bands calculated by them agree less well with those observed than in our case.

A more detailed paper will appear in the near future.

Phys. Institute, University, J. WEILER.
Freiburg i. Br., Germany.
Nov. 5.

[1] J. Weiler, *Helv. phys. Act.*, **5**, 302; 1932.
[2] E. K. Plyler, *Phys. Rev.*, **33**, 48; 1929.
[3] W. A. Parlin, *Phys. Rev.*, **34**, 81; 1929.

Spectrum of Cosmic Radiation

IN the note published by me in NATURE of September 24 under the above title, I find I made a numerical error in the observed limits of the 'soft band'. The observed and calculated values should be:

n	1	2	3	4	5	6
$h\nu$ (calc.)	475	160	80	48	32	23
$h\nu$ (obs.)	~450*	~180	~100	~50	(~30)	~25

Thus, the observed values given under $n = 4$ and $n = 6$ (not 5 and 7 as stated before) are the limits of the 'soft band'. They are estimated approximatively from its penetrating power, measured by Prof. R. A. Millikan[1] in comparison with that of γ-rays of thorium C″, the observed ratio being between 12 and 6.† The value ~ 30 million volts is an average, being at the same time the energy of formation of helium: $h\nu = 0{\cdot}032\ H.c^2$.

With this correction the agreement becomes more complete, the lack of the observed value under $n = 4$, noted in the preceding letter, having disappeared.

ADAM ST. SKĄPSKI.
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Mining Academy,
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Oct. 17.

* The probable value of the 'iron constituent'.
† The energy of γ-rays of thorium C″ being 2·5 million volts, the ratio 6 corresponds—from the Klein-Nishina formula—to 25 million volts.

[1] R. A. Millikan, NATURE, **128**, 709, Oct. 24, 1931.

Research Items

Animism and Child Psychology.- It is often maintained that the personifications of inanimate objects which are characteristic of the thought of the child in civilisation belong to a stage of mental development corresponding to that which is responsible for the animistic beliefs of peoples of lower culture. Ignoring the refinements of animistic belief, it may be said broadly that the reaction of the civilised child, in speaking of 'the naughty table' against which it has hurt its head, is regarded as comparable with the belief of the savage who holds that some spiritual force or power animates a block of wood or stone, for example, and may act, or be influenced to act, for good or ill. It has, therefore, been only reasonable to conclude that the same attitude of mind would be found, possibly even in an intensified form, in savage childhood; but a recent investigation raises some doubt as to the validity of the whole argument. Miss Margaret Mead has recorded the results of an investigation among the children of the Manus people of Admiralty Islands, New Guinea, with special reference to this point (*J. Roy. Anthrop. Inst.*, 62, pt. 1). Her investigation was conducted both by observation while the children were engaged in free activities, and by question. She found no evidence of animistic personification, although some of her experiments were directly provocative, had there been any tendency in this direction. The drifting of a canoe was attributed not to the innate perversity of the canoe, but to the carelessness of the person who failed to tie it up properly. The evidence, it is true, is drawn from a single people, among whom indeed conditions may be peculiar; but it suggests to Miss Mead, and will suggest to others, the need for a careful reconsideration of this theory of child psychology.

Early Migrations into America.—The evidence collected by a number of expeditions sent out by the Smithsonian Institution in recent years to the far north-west of the American continent has been reviewed by Dr. Aleš Hrdlička in its bearing on the problems of the early migration of man from north-east Asia to America (*Proc. Amer. Phil. Soc.*, 61, No. 6). The expeditions during the last six years have been engaged in systematic work in physical anthropology and archæology over an area extending from Point Barrow to Kodiak Island, and on the principal islands of the Bering Sea. A very large number of sites of ancient habitation have been located, a vast amount of skeletal and cultural material collected and a number of anthropometric observations made on the present inhabitants. Unsuspected rich old cultures have been revealed around the Bering Straits, on St. Lawrence Island, on the lower east coast of the Bering Sea and on Kodiak Island. The work is not yet finished; but it will not be long before the main question at issue shall have been cleared and ascertained fact substituted for the jungle of possibilities which has held the field until recently. The first two points which emerge are negative. Nothing has been found up to the present which indicates a very high antiquity, while it is evident that the Bering Sea region is continuously changing and that one or two thousand years ago the coastal map was quite different from what it is now. Therefore all hope of finding traces of earlier migrants to America must be abandoned. On the positive side, it is evident that once man arrived on the coast of north-east Asia, passing over to the visible coast on the American side was inevitable. Nor is it necessary to postulate a land bridge. Even had it existed man would have used the easier water route. Secondly, the migrations were gradual and disconnected. Thirdly, that man brought with him differences in type, language and culture; and fourthly, that he did not proceed to people America across the mainland, but by skirting the western and eastern coasts of Alaska. The Eskimo, a blood relation of the Indian, was the last comer.

Economic Exploitation of the Birds of Novaya Zemlya.—The transportation of chemical elements through food-chains terminating in the birds of such an area as Novaya Zemlya takes place on a vast scale. The elements of continental soils, transported by rivers, reach the sea, where some are assimilated in the organisms of the plankton. Thence they reach the bodies of fishes and so pass to the bodies of birds to be distributed afresh perhaps in places very far distant from their origin. The possibilities of such transference are suggested by the calculation that the daily catch of marine fishes approximates to a million kilograms, and the weight of fish caught by guillemots during their 120 days sojourn in Novaya Zemlya amounts to about 120,000 tons (L. A. Portenko, *Trav. Lab. biogéochimie Ac. Sci. U.R.S.S.*, Leningrad, 1931, pp. 52). The author describes 36 colonies of birds on the west of the island, and of these the guillemots occupy a coast line of 20 km. Probably they lay about 200,000 eggs, some of which are used by the inhabitants for feeding their blue foxes, while the flesh of the birds is eaten by the people and their dogs. The author also made a special investigation of the eider-down resources of the island, and found that in 1930 the total quantity exported to Gostorg was 457·5 kgm. He is of opinion that the quantities of guillemots' eggs and the production of eider-down offer opportunities for economic exploitation on a considerable scale.

Rapid Development of a Frog.—Dr. M. L. Sethi, of Government College, Hoshiarpur, India, has made some interesting observations on the rapidity of cellular development and of the attainment of the larval stage of *Rana tigrina*. Dr. Sethi states that the frogs spawn in the early hours of the day during the breeding season; the morula stage is reached within an hour and a half after the eggs are laid; epibolic gastrulation at the end of six and a half hours; and the neural plate and folds appear in about ten hours. The larvæ hatch out within twenty-four hours. This should be compared with the developmental history of the English frog, which takes usually a fortnight to reach the corresponding larval stage. Dr. Sethi further mentions that the external gills appear within a day after hatching and hind-limbs sprout three days after and fore-limbs two days subsequent to this period. The metamorphosis is completed in thirty-eight days while in Great Britain frogs take from seventy-seven to eighty-eight days. The development in a species of *Bufo* found in Hoshiarpur is similarly rapid.

Chromosome Constitution of *Sphenodon*.—Mr. R. D. Keenan (*J. Anat.* **72**, pt. 1, 1932) has investigated the chromosomal formula of *Sphenodon* and concludes that it has 36 chromosomes, 12 atelomitic chromosomes which are V-shaped, 18 telomitic chromosomes which are rod-shaped and six microsomes. Applying the theory of Robertson concerning the formation of V-shaped chromosomes to those of *Sphenodon*, the author concludes that the primitive number of chromosomes in Reptilia is 48, and he shows how the chromosomal formula of the living members of this group, which have been investigated, can be derived from this primitive number, principally by a reduction in the size of the individual elements and by a fusion of the elements in pairs or threes. The work of Painter has led him to the conclusion that the primitive number of chromosomes in the eutherian mammals is also 48, and that, though the type number in the marsupials appears to be 24, the total amount of chromatin seems to be about the same in the two groups. The significance of the number 48 as the typical primitive number in both Reptilia and Mammalia is commented on.

Effect of Length of Day on the Flowering of Plants.—Dr. M. A. H. Tincker, of the Wisley Laboratories, has two papers in the *Journal of the Royal Horticultural Society*, vol. 57, pt. 2 (pp. 321-325 and 326-331) dealing with the effect of the length of the daily light period on the growth of various plants. *Sedum spectabile*, *Saxifraga decipiens* var. *bathoniensis*, *Anchusa italica* and the tulip 'William Pitt' all behave similarly. They are 'long day' plants and flower earliest when exposed to the normal length of day in summer. A series which had twelve hours of daylight supplemented by five hours of weak artificial light behaved very similarly to the full daylight controls, but it was demonstrated that the weak artificial light was of no direct value for the formation of food in the leaves. Two other series which were exposed to twelve hours and six hours daylight respectively remained vegetative or flowered later than the controls. The other paper reports the results of studies on the rate of tuber formation. Several plants are mentioned which produce tubers when the daily period of light in summer is reduced to 10–12 hours. When the rate of translocation of foodstuffs to the tubers is represented as 100 for the controls, it is 60 for plants exposed to 12 hours daylight and 5–7 hours weak electric light, 130 for 10–12 hours daylight and 22 for 5–6 hours daylight. The effect of potassium economy is considered along with photo-period in its relation to the formation of tubers.

Igneous Complex of the Bushveld.—The great Bushveld complex of the Transvaal is universally recognised as the most spectacular manifestation of igneous activity to be seen anywhere in the world. The memoir on which Dr. A. H. Hall has been engaged for many years is now published (Geol. Survey S. Africa, Mem. 28, pp. 554, with coloured geological map) and a vast collection of field and laboratory data which petrologists have been eagerly awaiting is now available for digestion and discussion. Minor outpourings of felsitic rocks are found in the Rooiberg series at the top of the Transvaal system. A widespread felsite-granophyre composite followed, the upper extrusive portion remaining roofless. It is not yet clear whether the norite came next, to be followed in turn by the Red Bushveld granite, or whether the granite was emplaced before the norite. This is the outstanding problem that remains unsettled. More or less *pari-passu* with the intrusion of the norite magma the floor, made up of the Pretoria series, was injected by basic sheets. During the cooling and consolidation of the norite, thoroughgoing differentiation occurred with consequent highly developed pseudo-stratification of the crystalline accumulates, and at the same time slow and long-continued basining of the floor took place as a result of load above and magmatic adjustments in depth. Intense metamorphism of the rocks of the roof and floor is ascribed mainly to the action of the norite. Following widespread erosion of the complex, eruptive activity began afresh during the period between the close of the Waterberg and the beginning of the Karroo. The products included basic and alkaline sheets and dykes culminating in a number of plugs, stocks or ring-intrusions of alkali rocks of which the Pilandsberg is the most famous. The final chapter of the memoir is devoted to the mineral resources of the Bushveld, most attention being given to the occurrences of platinum.

Subsidence of London.—The various factors that may be involved in the subsidence of London as revealed by recent re-levelling have been enumerated with comments in a paper by Capt. T. E. Longfield (Ordnance Survey. Professional Papers No. 14. "The Subsidence of London". 2*s.* 6*d.*). These influences are as follows: (1) a general and gradual lowering of the land surface in the south-east of England, of which there is some evidence from the level of Roman remains of habitation. (2) A more local subsidence of the London area, especially in central London, of which there is measurable evidence at least since 1865. This appears to be confined to the thickly built-over areas where gravel or alluvium overlies the clay and may be due to the waterproof covering of stone, cement and asphalt that allows the underlying surface to drain and so contract. (3) A seasonal subsidence and uplift caused by changes in the water-content of the London clay. This is evidenced in disturbances in walls after a long dry spell. (4) Subsidence caused by the draining or pumping of water and sand from the gravel, which is known to disturb adjacent buildings. (5) Rhythmic land movement due to fall and rise of tide. Records show that Waterloo Bridge and the County Hall, Westminster, thus rise and fall. (6) Possible subsidence due to underground tunnelling, which may cause local sinking but not a widespread subsidence.

Limiting Static Friction between Lubricated Surfaces.—A paper by Sir William Hardy and M. Nottage (*Proc. Roy. Soc.*, Nov.) describes measurements of the limiting static friction between lubricated surfaces applied to the study of the behaviour of adsorbed layers. The measurements were made using a spherical sliding face of mild steel on a mild steel plane, and it is assumed that the lubricant is reduced to two primary layers with the surface of slip between them. The lubricants were solutions of wax or palmetic acid or hexadecyl alcohol in medicinal paraffin, and the temperature variation of the limiting friction was observed. The behaviour is different for the case in which the surfaces and the lubricant are brought together at the temperature of measurement and for the case when the lubricated surfaces are heated or cooled through a temperature range. In the latter

case, the curve depends on the temperature at which the oil is first applied to the surfaces. The authors discuss their results in terms of the 'availability' and 'accessibility' of the dissolved component to the surface. The former is the fraction of the surface covered by solute molecules when the surfaces are brought together; the latter represents the power of the solute molecules to seize adsorption surface when the conditions are changed. The accessibility depends upon the previous history of the system.

History of Terrestrial Magnetism.—*Terrestrial Magnetism and Atmospheric Electricity* for June contains an article of great interest, by Dr. A. Crichton Mitchell, entitled "Chapters in the History of Terrestrial Magnetism". It consists of a very condensed discussion (25 pages) of the discovery of the directive property of a magnet in the earth's field, and of the application of this property to the nautical compass. The discussion is based on the author's re-examination of the very extensive literature bearing on the subject: it is followed by more than three hundred bibliographical references and notes (occupying 15 pages of small print), referring, as a rule, only to original sources of information, almost all of which have been consulted or verified. The final conclusions arrived at are as follows: (*a*) while it is possible that the Chinese were acquainted with the directive property of a magnet by A.D. 1093, they made no further use of that property for at least two hundred years thereafter. (*b*) There is no evidence of the origin of any such knowledge among the Arabs, and it is improbable that they transmitted any information on the matter to Europe, their earliest mention of the compass being nearly half a century after its first mention in Europe. (*c*) The compass was in use in western Europe by A.D. 1187, and taking into consideration the fact that the directive property must have been discovered much earlier, it is most probable that a knowledge of that property, and its application, in western Europe was of independent origin and as early as, if not earlier than, that in China. A specially interesting passage describes the strange historical episode of the attribution of the invention of the mariner's compass to a non-existent person, Flavio Gioja, in 1302; a statue to the mythical Gioja has been erected in the Exchange at Naples, and the six hundredth anniversary of his supposed discovery was celebrated at Amalfi in 1901. The exposure of the legend, it may be added, is due to a distinguished Italian historian, Bertelli.

Astronomical Topics

Origin of the Planetary System.—Dr. H. Jeffreys has published a further paper on this subject (*Mon. Not. Roy. Ast. Soc.*, Oct.). He replies to some criticisms raised by Prof. F. Nolke on the theory that the system arose from the collision of a star with the sun; as regards the probability of such a collision, he shows from Prof. Nolke's own figures that such a collision should occur about once in 10^8 years, so that there may be about twenty systems younger than our own. Dr. Jeffreys points out that his revised theory is the only one that gives quantitative results for the rotations of the sun and planets that are of the right order of magnitude. He quotes a statement made last year by Prof. E. W. Brown that the accepted planetary theories as regards secular variations cannot be treated as valid for periods exceeding (say) ten million years; as the planetary system is probably thousands of millions of years old, it is quite possible that the present eccentricities of orbits might have been brought about by purely gravitational methods, without having recourse to resisting medium. He notes the difficulty in explaining the origin of the satellites of Mars, and suggests that they may be captured asteroids. But he makes a slip in stating that "this hypothesis has been strengthened by the discovery of a number of asteroids with mean distances less than that of Mars." There are many asteroids with *perihelion* distances less than that of Mars, but Eros, and possibly the newly discovered 1932 *HA*, are the only ones with smaller mean distances.

A Spectroscopic Study of the Brighter Stars of Type B_e.—Vol. 4, No. 13, of Publications of Michigan Observatory contains a paper on these stars by Mr. D. B. McLaughlin. They are stars that have bright emission lines; many of the stars are either known variables or suspected of variability. One of the aims of the present investigation was to test whether the ratio of brightness of the emission lines to that of the neighbouring continuous spectrum is constant in each star; another test applied was to compare the intensity of the red and violet components of bright double lines. Some of the stars on the list show variation in both the above ratios (they are denoted in the paper as the E/C and the V/R ratios) but as a rule, marked variation in one of the ratios is accompanied by steadiness in the other. Some of the stars lose their emission lines altogether for a portion of their cycle. Pleione in the Pleiades is stated to have had them in 1906, but they have not been observed since then; *f'* Cygni lost them for a time and then regained them. The question whether the variation in these stars is due to binary character is examined. One star on the list, Beta Lyrae, is a known binary. Another one, Upsilon Sagittarii, was supposed for a time to be a very massive binary; this was, however, questioned by Prof. Plaskett, and the present paper supports his view; it is suggested that the broad lines are widened by rotation, while the sharp ones originate in an outer shell of gas, at some distance above the photosphere. The article is accompanied by some enlargements of spectrograms, to illustrate the changes described.

Nautical Almanac Tables.—The Nautical Almanac Office is publishing a series of tables, which will be of great use to astronomical computers. Heliocentric co-ordinates of all the planets except Mercury are given from 1900 to 1940; for Jupiter and Saturn they go back to 1797. All positions are referred to the equinox of 1950, this uniformity being a great convenience in dynamical investigations. There are also extended precession tables for reducing data to the equinox of 1950. Coefficients are given for commencing investigations on the motions of heavenly bodies by the method of mechanical quadratures. This was the method used by Dr. P. H. Cowell for Jupiter's eighth satellite, and for Halley's comet.

Anniversary Meeting of the Royal Society

AFTER reference, according to "pious custom", to the work of the two foreign members and fourteen fellows of the Royal Society who died during the past twelve months, Sir Frederick Gowland Hopkins, in his anniversary meeting address on November 30 as president of the Society, made a plea for the establishment of chairs in the history of science. Individual scientific achievement is stored in fewer memories than is great literature, partly because it is but a step in the progress of knowledge. The perspective of history is specially valuable in maintaining sound judgments in these days of revolutionary views. Christopher Wren provides an example of a man whose services for experimental science have been overshadowed, except for the few, by other achievements. The tercentenary of his birth occurred during the past year, and also that of Antony van Leeuwenhoek and of Marcello Malpighi, both of whom were also associated with the Royal Society during its early years. The number of tercentenaries of original and early fellows of the Society falling during a small span of years makes it impossible to organise a public celebration of each such event.

Sir Frederick stated that the Society is to receive an important benefaction for the support of qualified investigators. Shortly before his death, Mr. Gordon Warren allocated to the Society the sum of £1,400 a year for seven years for the maintenance of a research professorship or two research fellowships. Two Warren research fellows, Dr. A. J. Bradley and Dr. W. Hume-Rothery were accordingly appointed last June. Mr. Warren died suddenly, leaving a large sum of money, subject to a life interest, which is ultimately to be devoted to science, and the Royal Society is to be consulted as to its disposal.

The Royal Society Mond Laboratory at Cambridge (NATURE, Feb. 13, 1932, p. 224) is practically complete and will be opened in February.

We print below extracts from the president's remarks in bestowing this year's medals.

Presentation of Medals

COPLEY MEDAL, awarded to DR. G. E. HALE

Dr. Hale's first notable achievement was in 1892, when he brought the spectroheliograph to success. This instrument gives a picture of the sun by the light of one spectrum line, and allows the bright clouds of hydrogen and calcium in the upper regions of the sun's atmosphere to be photographed as projected on the disc. The idea had been suggested and tried much earlier, but Hale was the first to make a workable automatic instrument of this kind. About the year 1895 Hale organised the building of the Yerkes Observatory and of the great refracting telescope there, to which an improved spectroheliograph was adapted. To this period belongs also a masterly investigation of the spectra of certain faint red stars. This was the precursor of a much larger enterprise, the Mount Wilson Observatory, with many unique instruments, such as the 150 ft. tower telescope and the 100 in. diameter reflector.

At the Mount Wilson observatory Dr. Hale made his great discovery of the Zeeman effect in sunspots by observing the circular polarisation of the edges of the broadened spectrum lines, where they cross the spot. Regions of thousands of miles across were thus shown to be the seat of intense magnetic forces, comparable in strength with those used in the dynamo machine. This discovery has been developed in many important directions.

In recent years Dr. Hale has developed the spectrohelioscope, an instrument depending on the persistence of vision, which allows us to observe transient phenomena scarcely accessible to the spectroheliograph. We may confidently expect that it will contribute to clearing up the mysterious relations between terrestrial magnetism and solar phenomena.

RUMFORD MEDAL, awarded to PROF. FRITZ HABER

Alike at Karlsruhe, where he went in 1894, and at Dahlem from 1911 to the present time, Haber has inspired schools of great and highly productive activity. His own early studies of the oxidation and reduction of organic substances by electrochemical methods, and the numerous electrochemical studies which followed this important work, such as his researches on gas cells, on the rate of ionic reactions, on the electrolysis of solid salts, on the velocity of reaction at electrodes, and on the use of the glass electrode, have enormously advanced progress in this branch of science.

Haber's profound study of the thermodynamics of gas reactions culminated the synthetic production of ammonia. With van Oort, he carried out a preliminary investigation on the ammonia equilibrium, but owing partly to discrepancy with figures obtained by application of the Nernst theorem, further experiments were made with le Rossignol in 1906. In 1908 satisfactory catalysts had been found and the synthesis of ammonia achieved. The far-reaching technical results of these careful thermodynamical studies are in themselves a monument to Fritz Haber; one of the German factories alone can produce more than 1,000 tons of ammonia daily. The influence of this on the food supply of the world is of the highest importance.

Haber's wide interest, combined with his insight and grasp, made possible the application of modern physical principles to a wide range of problems of physical chemistry, such as the determination of molecular structure and calculation of lattice energies, the nature of the amorphous state, chemiluminescence, reaction kinetics and electron emission during chemical reaction. During the past few years, Haber has been successfully making manifest the rôle of the hydrogen atom in combustion processes.

ROYAL MEDAL, awarded to PROF. R. ROBINSON

Prof. Robert Robinson has won world-wide distinction by his work in many branches of organic chemistry, particularly by his elucidation of the structure of plant products and of their phytochemical synthesis. No living organic chemist has displayed a greater versatility of thought and of method. His more recent researches on the distribution, the constitution and the laboratory synthesis of the anthocyanins, the pigments of flowers, fruits and berries, have excited the keenest interest of chemists and biologists. His work on the structure of alkaloids and the syntheses to which it has led

him are classical in character. The synthesis of tropinone has been referred to as the most elegant in chemical literature. On the mechanism of chemical reaction he has contributed theoretical ideas which, of interest both to chemists and physicists, have opened new avenues of investigation.

ROYAL MEDAL, awarded to PROF. E. MELLANBY

Prof. Edward Mellanby showed that the central factor in the development of rickets is a defective diet. He introduced experimental methods, produced rickets by feeding animals on a deficient diet, and showed that the missing factor was of the nature of a fat-soluble vitamin. Previously only clinical observations had been recorded, on the effect of sunlight, and on other supposed factors; there was no sound evidence that a material substance regulates the calcification of bone. It was Mellanby's fundamental work which during the last decade made possible numerous and important researches by others, culminating a year ago in the recognition of the material substance (vitamin D) as an isomeride of ergosterol.

Mellanby's later researches suggest hitherto unsuspected problems, though their very novelty has so far precluded the clear definition and finality which is now the outcome of his earlier works. Thus he has shown the adverse effect, in certain circumstances, of an excessive amount of cereal germs. In the absence of vitamin A the latter, and particularly ergot of rye, produce a degeneration of the spinal cord. Incidentally, this observation provides a satisfactory explanation of the peculiar and hitherto obscure incidence of convulsive ergotism in man.

DAVY MEDAL, awarded to PROF. R. WILLSTÄTTER

Prof. Willstätter's earlier studies gave us our present complete knowledge of the molecular structure of atropine and cocaine, and his analytic and synthetic studies of these alkaloids have had important sequels in systematic organic chemistry and in pharmacology. He then proceeded to a series of ingenious researches bearing on the problem of quinonoid character and on the benzene theory and these led in succeeding years to further work on cyclic compounds of much general interest. He early showed himself to be a master of method in organic chemistry. His name will, in the future, bring most readily to mind the discovery of magnesium in chlorophyll, and this, along with the painstaking and monumental investigations of the structure of chlorophyll and the blood pigment, represents the high-water mark of his achievement. Coupled with this work was a series of valuable contributions to the study of carbon assimilation. Equally novel and brilliant were his researches on the anthocyanin pigments of flowers and blossoms; a whole new chapter of organic chemistry was written. Finally, the studies on the enzymes have added greatly to our positive knowledge, enabled us fully to estimate the difficulty of the task, and laid down the lines on which future work must proceed.

DARWIN MEDAL, awarded to DR. C. E. CORRENS

Dr. Correns was one of the three botanists (the other two being Tschermak and de Vries) who in 1900 independently brought to the notice of biologists the fundamental work of Mendel, which had remained neglected since 1865. Since 1900 he has been actively engaged in developing the science of genetics. In 1902 Correns was the first to elucidate the remarkable phenomenon of the production of red flowers in the first cross between two white-flowered races of *Mirabilis*. He was also the first to show in the crossing of two species of *Mirabilis* that if very numerous genetic factors relating to small morphological differences are present, it is impossible to establish segregation in the F_2 generation, unless very large numbers are available. This explains the appearance of supposed 'constant' hybrids, as has since been shown by other observers in numerous instances.

Correns was also the first experimenter clearly to establish inheritance which did not follow Mendelian rules. Thus he showed in *Mirabilis* and other plants that variegation of the leaves depending on the failure to develop chlorophyll, is inherited only through the mother because the plastids which carry the chlorophyll are present in the egg cell and not in the sperm. Again, he demonstrated that paternal characters shown by extra-embryonal parts of fruits produced by crossing (so-called 'xenia') were always limited to the endosperm, that is, to the food tissue formed by the fusion of a second sperm with nuclei belonging to the maternal parent. But his most important work is probably the elucidation of the inheritance of sex. By crossing a monœcious with a diœcious species of *Bryonia*, he showed in 1907 that the females were all homozygous and the males heterozygous for the sex factor. The generalisation that one sex is always homozygous and the other heterozygous corresponds with the normal approximately equal distribution of the sexes in the offspring of unisexual individuals and with the differences between the chromosomes of the sex-cells, and is now well-established. Deviation from the equal distribution of the sexes Correns showed to be due in *Melandrium* to the more rapid action of the male-determining sperms, and this is a principle of wide application. Again, he was the first to explain the differential fertility of a generation of plants with their parents and with one another by the assumption of two distinct and inherited inhibiting substances in the stigmata of the flowers.

BUCHANAN MEDAL, awarded to PROF. T. MADSEN

Dr. Madsen's best known scientific work has been on the toxins and anti-toxins of diphtheria and tetanus bacilli and on other animal, vegetable and bacterial toxins and antigens and their antibodies. He initiated and published with Arrhenius, classical work on the theory of toxin and antitoxin combination, showing that the process resembled the combination of a weak acid and base rather than the union of a strong acid and base, as had been held by Ehrlich.

Madsen was largely concerned with the origin of the Commission on Hygiene, which he directed in Eastern Europe during the latter part of the War. Since then he has been president of the Health Committee of the League of Nations and president of the Permanent International Committee on Biological Standards, which was in great part due to his initiative.

HUGHES MEDAL, awarded to DR. J. CHADWICK

Dr. Chadwick is distinguished for his contributions to radioactivity and nuclear physics. Amongst a number of other investigations on α-, β- and γ-rays, he was the first to show explicitly about 1920 that the charge on the nucleus was equal to the atomic

number, by a quantitative study of the large-angle scattering of α-particles by selected elements, thus verifying by direct experiment the correctness of Moseley's deduction. He was associated with Rutherford, 1922–30, in a long series of investigations (1) on the anomalous scattering of α-particles by light elements, which threw the first light on the size and structure of the nucleus, and (2) on the artificial transmutation of the elements by α-ray bombardment. These experiments showed that at least twelve of the lighter elements were transmuted with the ejection of a proton, and laid the foundations of a study which has recently so rapidly accelerated.

In 1928 efforts were started to improve the technique of these experiments by using automatic electrical counting, and methods were perfected by the end of 1930. Dr. Chadwick applied the new methods to a more detailed study of the groups of disintegration protons, especially from boron and aluminium, for which he established clearly for the first time the existence of definite nuclear α-particle and proton levels. Finally, this year, when the observations by M. and Mme. Curie-Joliot had indicated certain curiosities produced by the supposed γ-radiation from beryllium bombarded by α-particles, Dr. Chadwick immediately recognised that the effects observed could only be adequately explained by the assumption that the radiation from beryllium was of a new type—the ejection of a neutron—and by a brilliant series of experiments he confirmed this conjecture, and with the collaboration of Dee and Feather was able to establish its essential properties.

The Place of Biology in Education

THE National Conference on the Place of Biology in Education, organised by the British Social Hygiene Council, which met at the British Medical Association House on November 1–December 3, may well prove a landmark in the history of education in Great Britain. When five Ministries, the chairmen of the Advisory Council to the Department of Scientific and Industrial Research, of the Medical Research Council, and of practically every educational body of importance, appear among the patrons, and when administrators and leaders of research such as Viscount Chelmsford, Sir Walter Fletcher, Sir Richard Gregory, Sir William Hardy, Prof. A. V. Hill, Sir Michael Sadler, Sir Amherst Selby-Bigge, and Sir Stephen Tallents appear side by side with men of high standing in the educational world, the public cannot dismiss their arguments as unimportant.

Since the purpose of the Conference was not to pass resolutions but to drive home the fact that competent judges in the spheres of national and imperial affairs, of research, of teaching, and of sociology are agreed upon the urgent necessity of providing the administrator, the social worker, and the ordinary citizen with a biological background, it would be difficult to imagine a gathering of greater weight, or one more likely to produce results.

Since it is hoped that a full report will shortly be available, it is as unnecessary as it would be impossible to attempt a detailed summary; but such an utterance of authoritative opinion certainly calls for a record of the general impression it left behind. The earlier speeches laid a firm foundation. Lord Chelmsford's account of the Prime Minister's committee over which he presided fittingly reminded those attending the Conference that they were deliberating matters of world-wide importance. Besides dealing with the specialist, the report of that committee emphasises the cultural value of biology, and states that no boy should leave school without some knowledge of it. Sir Michael Sadler, setting evolution against the background of the absolute, widened the horizon, and insisted that biological education demands a philosophy of life. Sir Walter Fletcher carried the theme further in a noble progression. Biology is essential in a mechanical age because it answers the human needs of utility, beauty, and worship. By putting utility lowest and then proceeding to show how neglect of biological research has lost us the sugar trade of the world, destroyed the trade in vegetable dyes, and brought us up against social problems even more anxious, while English wheat-growing has been saved by such research, he gave fitting emphasis to the higher needs. Prof. A. V. Hill laid stress on the fact that all science is one, and urged that since civilisation expresses the activity of a living organism, man, biological knowledge is essential to its understanding. Then speaker after speaker, from many-sided experience, while emphasising the danger of such specialisation as has overtaken chemistry and physics, impressed the truth that to be totally ignorant of biology is to be an incompetent citizen and a dangerous legislator.

More and more clearly emerged the demand for two kinds of biological training. The specialist is required for many purposes and the need is a growing one despite the economic set-back which has temporarily narrowed or closed some avenues; though if the specialist is not thoroughly trained in chemistry and physics his usefulness is greatly restricted. But unless every single citizen is educated in the understanding of biological ideas, then problems of industry, economics, population, and the mentally unfit, may prove too much for us. On every side the biological aspects of citizenship grow more significant and the need for biological education more urgent.

The fundamental note of the Conference was the recognition of this need, and of the corollary that in every stage of education, and for girls as well as for boys, biology must have its place. In the primary schools there has been little progress. Here Sir Richard Gregory wisely stressed the need of natural interest rather than of the illustration of scientific laws in the early stages. Other speakers showed how eagerly young children respond to teaching about the living organism.

The situation in teachers' training colleges, in central and secondary schools, in preparatory and public schools came under review, and the cry for more and better biology, biology on broader lines, was everywhere the same. Not least significant was the complaint of the headmaster of a preparatory school that there would be time for natural history if many parents did not so neglect early education that their sons reached the preparatory school unable to write grammatically or to do simple arithmetic. Nevertheless, it became clear that, in the opinion of the Conference, the preparatory schools could do an immense amount for the public schools by

encouraging Nature study. Not only the biological teaching, but also that important element, the school natural history society, would derive immediate benefit.

The representatives of the Headmasters' Conference spoke with a divided voice, suggesting that insofar as any unfavourable or reactionary views were expressed, they were individual rather than collective. While every sympathy attached to the warning against an over-loaded curriculum, and to the claim that to neglect chemistry and physics would be disastrous to biology, the general sense of the Conference seemed to be that rearrangement without overloading is both possible and necessary. Dr. Vaughan's timely warning that demands for biology should not be based on moral grounds found acceptance; on the whole, the Conference, while impressing the gain of biological teaching in which reproduction fell into its right perspective among the other functions of the organism, seemed to feel that any bias of the ordinary biological work in the direction of sex instruction is undesirable, though in some cases *ad hoc* courses, specially safeguarded, may prove helpful in day schools.

In fine, the National Conference on the Place of Biology in Education has pointed to a grave omission in the cultural training of citizens with a unanimity and an authority which cannot be disregarded. The situation must be put right; and the schemes submitted by Sir J. Arthur Thomson and others suggest a method for the earlier stages.

The nation owes a debt of gratitude to those who have helped in thus directing attention to a failure which is little short of disastrous, and in supplying a hope for the future. S. A. McDOWALL.

Alchemy and Alchemists*

IN a narrow sense, alchemy may be interpreted as the pretended art of transmuting the baser metals into silver and gold. In a wider sense it may be defined as the chemistry of the Middle Ages: according to Liebig, indeed, alchemy was never anything but chemistry. In its broadest aspect, it appears as a system of philosophy which claimed to penetrate the mystery of life and the formation of inanimate substances: it was thus a complex and indefinite blend of chemistry, astrology, philosophy, magic, mysticism, theosophy, and other ingredients.

To the philosophic alchemists, the efforts made by the adepts to transmute metals were mainly of interest as attempts to prove the truth, on the material plane, of an all-embracing philosophic system. The despised 'puffers', at the other end of the scale, were materially-minded seekers after gold. There were still others who interpreted the doctrines of alchemy in terms of mystical theology: thus, the celebrated Canon Ripley of Bridlington, in the prologue to his "Twelve Gates" (1471), wrote: "O Unity in the substance, and Trinity in the Godhead . . . as Thou didst make all things out of one chaos, so let me be skilled to evolve our microcosm out of one substance in its three aspects of Magnesia, Sulphur, and Mercury."

Heinrich Khunrath's quaint illustration of the alchemic citadel (1609), and Mylius's elaborate representation of the analogy of the alchemic microcosm to the macrocosm (1620) are examples of alchemy in its broadest interpretation, as are also the numerous illustrations which were collated in the "Viridarium Chymicum" in 1624 by Daniel Stolcius, a young Bohemian student. From such examples of its literature and iconography, alchemy appears as a jumble of natural and moral ideas, a confusion of objective facts and subjective notions, incorporating the fundamental principles of animism, and exhibiting ill-defined connexions with the story of the Grail and other confused records of forms of worship, superstitions, occultism, and the like.

Among the reputed adepts, none had a more circumstantial and romantic history than the Scottish alchemist, Alexander Seton, who has been termed "the chief martyr of alchemy". A century before his time, James IV of Scotland was interested in alchemy as a means of gold-making and of healing disease. His chief alchemical assistant was John Damian, who was created Abbot of Tungland in Galloway, in 1504, "so that he might have more leisure to carry on his experiments". Details of the expenses incurred in these experiments, many of which were conducted in the Castle of Striveling (Stirling), are still extant and form very interesting reading. The poet Dunbar said of Damian that "this Dignitary never chose to go to Mass though warned by the holy Bell"—apparently because he feared the defiling effect of the laboratory smoke upon his costly religious vestments.

"This tyme," says an old record, "thair wes ane Italiane with the King, quha wes maid Abbott of Tungland, and wes of curious ingyne. He causet the King believe that he, be multiplyinge and utheris his inventions, wold make fine golde of uther mettall, quhilk science he callit the quintassence; quhairupon the King maid greit cost, bot all in vaine. This Abbott tuik in hand to flie with wingis, and to be in France befoir the saidis ambassadouris; and to that effect he causet mak ane pair of wingis of fedderis, quilkis beand fessinit apoun him, he flew of the castell wall of Striveling, bot shortlie he fell to the ground and brak his thee bane; bot the wyt theirof he asscryvit to that thair was sum hen fedderis in the wingis, quhilk yarnit and covet [yearned and coveted] the mydding and not the skyis."

*Substance of a paper presented by Prof. John Read to the Folk-Lore Society on November 30.

University and Educational Intelligence

BIRMINGHAM.—Mr. Frank Postlethwaite has been appointed James Watt fellow for the current session.

CAMBRIDGE.—Prof. B. L. van der Waerden, of the University of Leipzig, has been appointed Rouse Ball lecturer for the year 1932–33, and Prof. Hans Geiger, of the University of Tübingen, Scott lecturer for the year 1933.

The General Board recommends that an Alfred Marshall lectureship be established in the Faculty of Economics and Politics.

Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, formerly scholar and fellow, has been elected to an honorary fellowship at King's College.

Dr. H. R. Hulme has been elected to an unofficial Drosier fellowship at Gonville and Caius College for research in mathematical physics. Dr. Hulme was placed in the first class of Part I of the mathematical tripos in 1927 and was a wrangler with distinction in 1929. He won a Smith's prize in 1931 and was elected an Isaac Newton student in 1932.

LONDON.—A University postgraduate travelling studentship of the value of £275 for one year has been awarded to Mr. W. B. Mann, Imperial College of Science and Technology, who proposes to carry out research on rarefied gases, in particular to determine the molecular conductivities, at Copenhagen.

THE opening ceremony in connexion with building extensions at the Northampton Polytechnic Institute, St. John Street, E.C.1, was performed by H.R.H. Prince George on the evening of December 2. Nearly 90 per cent of the 3,000 students of the Polytechnic attend evening classes. There are also important day departments providing courses in engineering and ophthalmic optics. The former are recognised by the University of London for the purpose of internal degrees, as are also courses of similar type conducted in the evening. The extension occupies part of a site with street frontage on three sides facing the main Polytechnic building. In addition to further lecture rooms and class-rooms, accommodation is provided for the chemistry and horological sections; there are also a large workshop for instruction in lens-making and automobile laboratories. The building, which, apart from site, furniture and equipment, has involved an expenditure approximating to £45,000, comprises basement, ground floor and four stories above. The total floor area is approximately 28,000 sq. ft., of which nearly 20,000 is directly 'useful'. Rooms occupied by the chemistry section include lecture room and two laboratories for general chemistry on the first floor, with laboratories for fuels, electro-deposition, metallurgy and metallography immediately above. The watch and clock-making department occupies the fourth floor and comprises separate workshops for clock-making and watch-making, timing laboratory, master clock station and drawing office. The provision of these additional premises is designed to permit of considerable expansion within the main building of laboratory and workshop accommodation for engineering and physics.

Calendar of Geographical Exploration

Dec. 12, 1639.—Exploring the Amazon

Pedro de Teixeira arrived at Pará after his journey to Quito. Teixeira had become Governor of Pará in 1618 and had ascended the Amazon and its tributary, the Tapajos, in quest of slaves. In June 1637 two friars had launched a boat on the Napo and thence sailed on the Amazon to its mouth. Their adventure suggested the possibility of navigating the Amazon, and Teixeira set out late in 1637 to explore the river route to Quito. The Portuguese explorer slowly and with difficulty accomplished the journey against the current. From Quito he again returned by the river, noting the confluences of its tributaries. Information was also gained of the connexion with the Orinoco by means of the Cassiquiari, though this news was received with incredulity.

Dec. 13, 1577.—Sir Francis Drake

Sir Francis Drake sailed on his circumnavigation of the globe, the first carried out by an Englishman. He was apparently commissioned to examine the coast of Terra Australis as shown on the map of Ortelius 1570. But he certainly knew of the insular character of Tierra del Fuego and quite probably rounded Cape Horn; thus his journey disproved the map. He also reported a good bay on the west coast of America in lat. 43° N. This report, like that of Juan de Fuca, who was said to have discovered, in 1592, a strait in 47° N., greatly stimulated the search for a north-west passage.

Dec. 13, 1835.—Exploration of the Irrawaddy

Capt. S. F. Hannay arrived at Katha on the Irrawaddy. He proceeded to Bhamo and explored the Mogaung River. From Mogaung he went to the amber mines of the Hukawng valley, but the miners distrusted his Burmese escort and he returned by the route along which he had come to Ava. Until his time Ava had been the farthest point reached on the Irrawaddy. Hannay's voyage suggested that there was little possibility that the Tsang-po (Brahmaputra) flowed into the Irrawaddy, as was supposed by some to be the case; in 1886 Needham definitely proved that there was no connexion between the two rivers.

Dec. 14, 1911.—Roald Amundsen

Roald Amundsen, the famous Norwegian explorer, reached the south pole and remained there taking observations until Dec. 16. In 1903–6, Amundsen had achieved the navigation of the north-west passage, which had for centuries baffled explorers. A small sealing sloop, the *Gjöa*, was fitted with a motor and strengthened to withstand ice. She left Christiania on June 17, 1903, with six men only, passed through Lancaster Sound down the west side of Boothia Felix and wintered in Gjöa Harbour, King William Island. Here the ship remained for two years and sledging excursions were made to the magnetic north pole and the coast of Victoria Island was charted to 72° N. The *Gjöa* proceeded westward, but was frozen in off King Point, where a third winter was passed. On July 11, 1906, she got free and then sailed through Bering Strait into the Pacific. Thus at last was realised the dream of early mariners. In 1918–21 Amundsen made the north-east passage, wintering three times on the Siberian coast. On May 11, 1926, two days after Commander Byrd had flown from Spitsbergen to the north pole and back, Amundsen flew in the airship *Norge* from Spitsbergen across the pole to Teller, Alaska, a distance of 3391 miles in 72 hours. Amundsen left Bergen in an aeroplane on June 17, 1928, to search for Nobile after the wreck of the airship *Italia*, and was never heard of again.

Dec. 17, 1837.—Sir George Grey in Australia and New Zealand

Sir George Grey started an inland journey from Prince Regent River in an endeavour to reach the Swan River, but was unable to do more than explore the Glenelg and Prince Regent Rivers, owing to a wound received in a struggle with natives. In 1838 he attempted an exploration of the coast north and south of Shark's Bay, but his three boats were wrecked and the party had to tramp overland from Cantheaume Bay to Perth, a distance of 300 miles. Grey pushed on ahead to bring relief to the party and walked into Perth on April 20, so changed by suffering that his friends did not know him. The expedition resulted in the discovery of some ten rivers, including the Gascoyne, Murchison, Greenough and Irwin, as well as parts of the Darling and Victoria Mountains. In 1841 Grey became Governor of New Zealand where he took a keen interest in the Maori, who in turn were devoted to him. His scholarly collection of their legends and myths has become a classic.

Societies and Academies

London

Geological Society, Nov. 9.—**C. T. Madigan:** The geology of the Western MacDonnell Ranges, Central Australia. The sections of previous investigators, including those of the Horn Expedition, H. Y. L. Brown, and L. K. Ward, are correlated, and the formations are traced and mapped throughout the area. The stratigraphical position and actual location of the very important Horn Valley, with its Ordovician fossils, are finally established. A new Ordovician fossil locality in the James Ranges is recorded, and the first geological account of the Waterhouse Range is given. The Central Australian formations are reclassified and the age of the beds is fully discussed.—**T. N. George:** The Carboniferous Limestone series in the west of the Vale of Glamorgan. The stratigraphical sequence in the Avonian is comparable with that established in Gower to the west by Dixon and Vaughan, and in the district around Ruthin and Miskin to the east by Dixey and Sibly. The normal succession of zones is displayed, without any marked departures from the characteristic lithological types of each. As a whole, the series was probably deposited in slightly deeper water than the Gower Series, and dolomite is poorly developed. The rocks over the greater part of the area are folded into a pitching anticline, the Candleston anticline, the axis of which falls eastward. Over the western part of the area, around Porthcawl, the strata are almost horizontal, only D_1 being exposed. A number of minor north-and-south faults traverse the rocks, at least one of which is a tear of post-Triassic age.

Physical Society, Dec. 2.—**Lewis F. Richardson:** Time-marking a kathode-ray oscillogram. Time marks have been arranged as little blurs or gaps in the trace, by periodically unfocusing the electron stream. The current in and voltage across a conductor can thus be recorded together with the time on a single oscillogram.—**J. F. Herd:** The generation and reception of wireless signals of short duration. In the use of short-duration signals for investigation of the ionosphere, it is convenient to emit the signal pulses at a controlled rate and to receive them on an oscillograph giving temporal discrimination between the arrival of the ground ray and that of subsequent echoes. Simplification of recording technique can be obtained if, at the receiver, an oscillograph of the cathode ray type is used in conjunction with a time-scale voltage of which the rate of recurrence is exactly the same as that of the emitted impulses. The paper describes methods of utilising the common frequency of an A.C. supply network to secure such synchronisation.—**R. Naismith:** A comparison of the frequency-change and group-retardation methods of measuring ionised-layer equivalent heights. Measurements are conducted under as varied conditions as possible. The results appear to confirm the theoretical investigation recorded by Appleton in 1928. The apparatus used to measure the amount of the frequency change employed in the measurements is described.—**H. L. Wright:** The influence of atmospheric suspensoids upon the earth's magnetic field, as indicated by observations at Kew Observatory. Changes in the electrical resistivity of the air and in the potential gradient may be associated with changes in the concentrations of gross particles and of condensation nuclei. Observations of these four quantities made at Kew Observatory over a period of three years indicate that resistivity depends upon the number of gross particles and of condensation nuclei, while potential gradient varies with resistivity and the number of nuclei.

Dublin

Royal Irish Academy, Nov. 14.—**L. B. Smyth:** *Cleistopora geometrica*, Milne-Edwards and Haime. Specimens of this curious Devonian coral from the type locality, Sarthe, France, were studied. Tabulæ, said by Nicholson (1888) to be absent, are demonstrated. The mural pores are shown to be straight, not tortuous. A wrinkled epitheca appears where the corallum extends beyond the supporting brachiopod shells. Separation of the index fossil of the Lower Carboniferous *Cleistopora* zone from this form is fully supported by the investigation.—**R. Lloyd Praeger:** Some noteworthy plants found in, or reported from, Ireland. Careful investigation during 1931–32 has proved in the author's opinion, that *Arbutus Unedo* is native on Lough Gill in Sligo—heretofore it has been known only from Kerry and West Cork, though place-names point to its former extension as far north as Mayo. *Cochlearia anglica* is present everywhere round the Irish coast. The claims of *Arctostaphylos alpina* and *Selaginella Kraussiana* reported from Ireland to a place in the flora are not admitted.—**R. Patten:** Observations on the cytology of *Opalina ranarum* and *Nyctotherus cordiformis*. The endoplasmic bodies in *Opalina ranarum* are flattened disc-like bodies, with the flat side generally parallel to the flattened surface of the organisms; the rod or dumb-bell-shaped forms and the irregular or spherical bodies are but two aspects of the same structure. Mitochondria are present as small spherical structures revealed by chrome-osmium techniques, and also by intra-vitam staining with Janus green. Blackened bodies, shown by Da Fano's silver method, in the outer regions of *Opalina* may be Golgi elements. *Nyctotherus* bacteria, both bacilli and cocci, are seen by various fixatives, in the cytoplasm. No Golgi apparatus has been revealed. Large numbers of smaller bodies are preserved by many methods. These as well as bacteria are Gram positive, but in spite of resemblances the former are not bacteria—they are probably modified mitochondria.

Paris

Academy of Sciences, Nov. 2 (vol. 195, pp. 725–740).—**Paul Pascal and Jean Grévy:** The action of ammonia and amines on the viscosity of collodion. The effect of ammonia on the viscosity of solutions of guncotton in ether-alcohol mixtures is a function of the time. There is, at first, a rapid increase in the viscosity followed by a decrease. Viscosity time curves are given showing the effects of increasing quantities of ammonia. The fatty amines produce a similar but more marked effect and a diagram is given showing the comparative effects of ammonia, methylamine, dimethylamine and ethylamine.—**André Haarbleicher:** Some new properties of the trajectories of points linked *à un trois barres*.—**Henry Girerd:** The measurement of the aerodynamical characteristics of a supporting wing in a plane current.—**L. Malavard:** The fundamental problem concerning the (aeroplane) wing of finite spread.—**Jacques Bourcart:** The marine deposits of the second Miocene cycle of western Morocco.—**Marc Simonet:** Chromosome counting in the

genera *Baptisia*, *Thermopsis* and *Lathyrus*. Twenty-four species of *Lathyrus* give the same number of chromosomes, 7: *Baptisia* and *Thermopsis* have the same number, 9.

ROME

Royal National Academy of the Lincei, June 19.—L. Petri: *A photoelectric method for demonstrating* Gurwitsch's mitogenetic radiations. Results obtained by a new method confirm Rajewsky's conclusion, that the radiation discovered by Gurwitsch is emitted even in complete darkness. They show, moreover, that a paste made from the germinating caryopsids of grain is less active in this respect than the whole caropsids and continues to yield the radiation for only about thirty minutes instead of for several hours.—P. Clemente: New majoration formulæ for the periodic solutions of an ordinary linear differential equation of the second order.—M. Ghermanesco: Laplace's equation. The application of Laplace's equation for a plane to a space of n dimensions is considered.—Hans Hamburger: Ribaucour's transformation and spherical representation. (1) Remarks on the general theory of Ribaucour's transformation.—M. Picone: Integral equation translating the most general linear problem for the ordinary linear differential equations of any order.—U. Cassina: The pendulum of variable length.—L. S. Da Rios: Auto-rotating rotor cylinders.—E. Martin: Method for calculating the orbit of a visual binary.—G. Agamennone: The presence of slow waves *in the preliminary phase of certain seismograms*.—G. A. Barbieri and A. Tettamanzi: New complex compounds of silver cyanide with sodium cyanide. The presence of the complex $Ag(CN)_3$ in crystalline compounds has been shown by the preparation of additive products of sodium, magnesium, and calcium argentocyanides with hexamethylenetetramine. It is now found that sodium and silver cyanides form, besides $NaAg(CN)_2$, also the compounds $Na_2Ag(CN)_3$, $3H_2O$ and $Na_3Ag(CN)_4$, $5H_2O$, both of which are obtainable in the crystalline condition.—A. Corbellini and M. Angeletti: Stereoisomerism of 2 : 2′-disubstituted derivatives of diphenyl (2). Fractional crystallisation from alcoholic solution of the brucine salt of racemic 2-[bis-phenylhydroxymethyl]-2′-diphenylcarboxylic acid yields, in larger amount, the less soluble lævo-rotatory salt.—G. Devoto: Magnetic susceptibility of the carbamides, isocarbamides, and sulphamide. Investigation of these compounds in the solid state reveals again the negligible effect of isomerism on diamagnetism, the empirical formula being of fundamental importance in this respect.—F. Garelli and G. Racciu: Triphenyl phosphate as a solvent in cryoscopy (1). Although certain compounds exhibit somewhat anomalous behaviour, the value 120 may be taken as the value of the molecular freezing-point depression of triphenyl phosphate; the value calculated by means of van 't Hoff's equation is 117·6.—A. Boni: The Miocene of Monte Vallassa.—R. Redini: The geology of Monte Pisano. Observations are described which are at variance with the conceptions of previous investigators on the stratigraphy and tectonics of this region.—Giuseppina Dragone-Testi: A new microchemical method for the separation of the cellulose in vegetable membranes. Paternò's method for dissolving cellulose for industrial purposes—digestion of the fibrous material with copper acetate solution, precipitation with sodium carbonate, dissolution of the precipitate in aqueous ammonia, and reprecipitation by acid—may be applied to the microchemical analysis of vegetable membranes.—G. Montalenti: The embryogenesis of hybrids of *Bufo vulgaris* and *Bufo viridis*.—Constantino Gorini: The coagulation of milk by the action of *Bacillus typhi* and other bacteria regarded as inactive towards milk. Chymase is widely distributed in parasitic bacteria, its formation being a normal function of the micro-organisms, independently of the presence of milk and casein. When milk which has been subjected to gentle sterilisation is poured on to vigorous agar cultures of *B. typhi*, *B. morgani*, and *B. hypolyticum*, coagulation occurs, although these bacteria are considered to be without action on milk. The enzyme occurs also in various bacteria which do not liquefy gelatine.—M. Mitolo: Action of vapours of vegetable essences and of animal aromas on medullary reflex excitability.

SYDNEY

Royal Society of New South Wales, Sept. 7.—V. M. Trikojus and D. E. White: The chemistry of the constituents of the wood-oil of the 'Callitris' pines. (1) The constitution of 'callitrol'. Chemical investigation of the wood-oil of the typical native pine of Australia, the 'Callitris' species, has shown that the substance 'callitrol' chiefly responsible for the anti-termite properties of the timber is identical with *l*-citronellic acid, this being the first record of its occurrence in Nature. H. G. Smith had considered 'callitrol' to be a phenol, but its constitution has now been proved beyond doubt. Chemical investigation of the other constituents of the oil, particularly of the sesquiterpene alcohol, guajol, is proceeding.—Burnett Mander-Jones and V. M. Trikojus: The synthesis of bases allied to coniine. (1) The preparation and pyrolysis of the allyl ethers of *N*-heterocyclic enols. The migration of the allyl group in the *o*-allyl ethers of *N*-heterocyclic enols has been studied with the object of synthesising substances allied to the alkaloid, coniine. The ethers of 4-oxy quinaldine and its derivatives have been chiefly investigated, and it has been found that the allyl group wanders invariably to carbon in various positions in the ring, rather than to nitrogen, which is contrary to the prediction of other workers. The constitutions of the re-arranged products have been proved by synthesis, and reduction has led to the preparation of bases, the physiological properties of which are being studied.—V. M. Trikojus and D. E. White: A note on the constitution of tasmanol. 'Tasmanol', occurring in the cineol-phellandrene-bearing class of eucalypts, was considered by Smith and Robinson to be a phenol. The substance isolated from the leaves of *Eucalyptus Risdonii* has now been shown to be an acid, $C_{13}H_{22}O_3$, yielding a crystalline *p*-toluidide, and a silver salt. A methoxyl group is also present. The characteristic blood-red colour yielded by the substance with ferric chloride is due to the formation of a coloured ferric salt. The elucidation of the structure is not yet complete.—F. P. J. Dwyer, D. P. Mellor, and V. M. Trikojus: The use of potassium dichromate and sodium nitrite in aromatic nitrosations. A mixture of potassium dichromate and sodium nitrite in the molecular proportions of 1 : 2, or of sodium nitrite, with a trace of the dichromate or chromate associated with a stream of carbon dioxide, can be used to introduce the nitroso group into organic molecules under extremely mild conditions. The conditions can be so arranged that the reaction occurs entirely under neutral or slightly alkaline conditions. The

reaction has been carefully followed electrometrically, using the glass electrode, for the rapid production of pure diazo-amino benzene.—A. R. Penfold and J. L. Simonsen : The essential oils of three species of *Geijera* and the occurrence of a new hydrocarbon (2). The new substance to which the name 'geijerene' has been given, possesses the formula $C_{12}H_{18}$. Unfortunately, it does not yield any crystalline derivatives. Despite the large number of experiments, no evidence has yet been obtained which would enable the authors to suggest a constitution for the hydrocarbon.

Forthcoming Events

SATURDAY, DEC. 10

BRITISH PSYCHOLOGICAL SOCIETY, at 3—Annual General Meeting at Bedford College, Regent's Park, N.W.1.

MONDAY, DEC. 12

ROYAL SOCIETY OF ARTS, at 8—(Fothergill Lecture).—Maurice E. Webb: "The Design and Construction of Buildings in Relation to Fire Risks".

ROYAL GEOGRAPHICAL SOCIETY, at 5—Dr. J. Georgi: "The Scientific Results of the Wegener Expedition to Greenland".

SOCIETY OF CHEMICAL INDUSTRY (YORKSHIRE SECTION), at 7.15—(Jubilee Memorial Lecture).—Dr. E. F. Armstrong: "Alcohol through the Ages" (to be repeated before other Sections).

TUESDAY, DEC. 13

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30—(Harrison Memorial Lecture).—Sir Henry Dale: "Therapeutic Problems of the Future".

WEDNESDAY, DEC. 14

ROYAL SOCIETY OF ARTS, at 8—S. P. B. Mais: "The Work of the National Trust".

INSTITUTION OF CHEMICAL ENGINEERS, at 5.30—(at the rooms of the Chemical Society, Burlington House, W.1).—Conference on "Testing of Chemical Plant". Papers by A. L. Bloomfield, Prof. W. E. Gibbs and Dr. A. J. V. Underwood.

NEWCOMEN SOCIETY, at 5.30—(in the Science Museum, South Kensington, S.W.7).—Public Lecture by F. Nasmith to commemorate the bicentenary of Sir Richard Arkwright.

BRITISH PSYCHOLOGICAL SOCIETY (MEDICAL SECTION), at 8.30—Dr. John Rickman, Mrs. E. Brackenbury, Dr. William Brown and E. Glover: Symposium on "Psychology and Psychical Research".

THURSDAY, DEC. 15

UNIVERSITY OF BRISTOL, at 5.15—(Henry Herbert Wills Memorial Lecture).—Lord Rutherford: "Atomic Transformations".

CHEMICAL SOCIETY, at 8—Discussion on "The Chemistry of Sterols, with Special Reference to Ergosterol", to be opened by Prof. I. M. Heilbron.

FRIDAY, DEC. 16

ROYAL INSTITUTION, at 9—Sir George Macdonald: "Roman Wall in Scotland".

Official Publications Received

GREAT BRITAIN AND IRELAND

Two Lectures on an "Outline of an Electrochemical (Electronic) Theory of the Course of Organic Reactions". By Robert Robinson. Pp. 52. (London: Institute of Chemistry.)

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Thirty-sixth Session, adopted at the Meeting of Governors held on the 18th October 1932. Pp. 73. (Glasgow.)

The Scottish Forestry Journal: being the Transactions of the Royal Scottish Forestry Society. Vol. 46, Part 2, October. Pp. xvi+97–216+25–34. (Edinburgh: Douglas and Foulis.) 7s. 6d.

The School Certificate Examination: being the Report of the Panel of Investigators appointed by the Secondary School Examinations Council to enquire into the eight Approved School Certificate Examinations held in the Summer of 1931. Pp. 161. (London: H.M. Stationery Office.) 2s. 6d. net.

Census of India, 1931. Abstract of Tables giving the Main Statistics of the Census of the Indian Empire of 1931; with a Brief Introductory Note. Pp. 16+2 maps. (London: H.M. Stationery Office.) 9d. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1481 (T.3230): Estimation of Wing Surface Area for Evaporative Cooling. By C. Anderton Brown and A. W. Morley. Pp. 23+12 plates. 1s. 6d. net. No. 1488 (T.3276): Slipstream Effect on the Downwash and Velocity at the Tailplane. By F. B. Bradfield. Pp. 7+15 plates. 9d. net. (London: H.M. Stationery Office.)

Report of Delegates of the United Kingdom of the 25th Meeting of the International Council for the Exploration of the Sea, held in Copenhagen from June 20th–25th, 1932. Pp. 10. (London: Ministry of Agriculture and Fisheries.)

OTHER COUNTRIES

Transactions of the San Diego Society of Natural History. Vol. 7, No. 16: Descriptions of Heretofore Unknown Mammals from Islands in the Gulf of California, Mexico. By William Henry Bury. Pp. 161–182. Vol. 7, No. 17: A Southern Race of the Spotted Screech Owl. By A. J. van Rossem. Pp. 183–186. Vol. 7, No. 18: Notes on the Desert Tortoise (*Testudo agassizii*). By Prof. Loye Miller. Pp. 187–208+plates 10–11. (San Diego, Calif.)

University of Michigan: School of Forestry and Conservation. Bulletin No. 1: Foods of some Predatory Fur-bearing Animals in Michigan. By Prof. Ned Dearborn. Pp. 52+4 plates. (Ann Arbor: University of Michigan Press.) 25 cents.

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 12, 1930. vi. Aerologiska iakttagelser i Sverige. Pp. 40. 3 kr. Meddelanden, Band 5, No. 6: Lancers de ballons-sondes d'Abisko de 1921 à 1929. By Bruno Wolf. Pp. 42+9 planches. 3 kr. (Stockholm.)

Publications of the Observatory of the University of Michigan. Vol. 4, No. 14: The Spectrum of b^3 28 Cygni. By Hazel Marie Losh. Pp. 199–216. Vol. 5, No. 1: Elements and Ephemeris of Comet Peltier-Whipple (1932k). By Allan D. Maxwell. Pp. 4. (Ann Arbor, Mich.)

New Zealand: State Forest Service. Annual Report of the Director of Forestry for the Year ended 31st March, 1932. Pp. 16. (Wellington, N.Z.: W. A. G. Skinner.)

Forest Bulletin No. 79: Calorific Values of some Indian Woods. By S. Krishna and S. Ramaswami. Pp. 27. (Calcutta: Government of India Central Publication Branch.) 12 annas; 1s. 3d.

Dominion of Canada. Report of the Department of Mines for the Fiscal Year ending March 31, 1932. (No. 2315.) Pp. iii+50. (Ottawa: F. A. Acland.) 25 cents.

The South African Journal of Science. Vol. 29: Being the Report of the Thirtieth Annual Meeting of the South African Association for the Advancement of Science, Durban, 1932, 4 July to 9 July. Pp. vi+iii+866. (Johannesburg.) 30s. net.

Paleontologiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 2, Stuk 4: Vrystaatse Wilde Varke. By Dr. Ir. E. C. N. Van Hoepen and H. E. Van Hoepen. Pp. 39–62. (Bloemfontein.)

India: Meteorological Department. Scientific Notes, Vol. 4, No. 44: Thunderstorms in the Peninsula during the Pre-Monsoon Months April and May. By S. P. Venkiteswaran. Pp. 145–152+6 plates. 1.10 rupees; 2s. 9d. Scientific Notes, Vol. 5, No. 46: On Solitary Gusts associated with Reversals of Pressure Gradients. By S. Atmanathan. Pp. 10+1 plate. 10 annas; 1s. (Calcutta: Government of India Central Publication Branch.)

Ministry of Finance, Egypt: Coastguards and Fisheries Service. Observations on the Size and Growth of two Egyptian Mullets, *Mugil cephalus* (Linn.), the "Bouri", and *M. capito*, Cuv., the "Tobar". By R. S. Wimpenny. Pp. ii+53+4 plates. (Cairo: Government Press.)

Japanese Journal of Geology and Geography. Transactions and Abstracts, Vol. 10, Nos. 1 and 2, October. Pp. iii+82+11+5 plates. (Tokyo: National Research Council of Japan.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 393: Tensile Properties of Copper at Low Temperature. By Masawo Kuroda. Pp. 163–167. 15 sen. Nos. 394–397: The Change of Wave-Length and Intensity in Iron, Nickel and Titanium Lines by Disruptive Discharge, by Hantaro Nagaoka, Tetsugoro Futagami and Iwajiro Machida; On the X-Ray Study of the Density Distribution in the Discharge Tube, by Yoshio Ishida and Toyotaro Suetsugu; Researches on the Anodic Film of Aluminium, 1: Effect of Concentration of the Electrolyte on the Formation of Anodic Film, by Shoji Setoh and Akira Miyata; Researches on the Anodic Film of Aluminium, 2: Anodic Behaviours of Aluminium in Aqueous Solutions of Oxalic Acid, by Shoji Setoh and Akira Miyata. Pp. 169–291+plates 16–21. 1.35 yen. Supplement No. 16: Study on the Corrosion of Gray Cast Iron by Nitric Acid—The Exothermic Phenomenon of Gray Cast Iron Piece in Nitric Acid Solution and at its Surface in Atmosphere after Corrosion by Nitric Acid. By Yôichi Yamamoto. Pp. 11. 15 sen. (Tokyo: Iwanami Shoten.)

Department of Agriculture: Trinidad and Tobago. Flora of Trinidad and Tobago. Vol. 1, Part 5: Rosales (concl.); Myrtales (pars). By R. O. Williams. Pp. 309–332. (Trinidad: Government Printing Office.) 1s.

Memorias del Consejo Oceanográfico Ibero-Americano. No. 12: Procedimientos para fondear un navis a grandes profundidades para medida directa de corrientes. By Dr. F. Spiess. Pp. 48. No. 13: Problemas principales de la Oceanografía del Pacífico. By Dr. Thomas Wayland Vaughan. Pp. 31. (Madrid.)

CATALOGUES

Beck Luminex Magnifier. Pp. 6. (London: R. and J. Beck, Ltd.)

Catalogue of Astronomical Telescopes and Accessories. Twenty-third edition. Pp. 24. (London: W. Watson and Sons, Ltd.)

SATURDAY, DECEMBER 17, 1932

CONTENTS

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Control of Animal Pests

IT is a commonplace of biological science that no man can reckon where the repercussions of interference with Nature will end. Although examples of interference, made deliberately and with the best intention, which have turned out disastrously are abundant, new examples are always instructive if only for the reason that the lesson of far-reaching results seems to be a difficult one to learn.

No better instance of the kind is to be found than that which is developing before our eyes at the present moment. Five years ago musk-rats (musquash) were introduced into Great Britain to be bred for their fur ; some individuals escaped or were released, and now they occur in certain areas in such numbers that they form a very serious menace to agriculture and other vital interests. In the House of Lords, on December 7, the Earl de la Warr stated that in Shropshire thirty trappers are catching sixty to eighty musk-rats each week. Even so, they are but touching the fringe of the problem in that area, and there are many other areas where musk-rats are at large. Here is a grave problem to which we hope to return in these columns.

Yet another example of unforeseen results is afforded by the intensive destruction of predatory animals which has been taking place in parts of the United States, often under the auspices of Government departments. It is due in great part to the desire of increasing numbers of American citizens to shoot something, and to the difficulty, where hunters are so numerous, of obtaining something for all to shoot. The first impulse has been to organise the slaughter of the reputed enemies of game, the beasts of prey.

Already it begins to be apparent that this may be a mistaken policy. Poisoning campaigns tend directly to weed out the wrong as well as the right animals, and reports from California show how serious the threat may be to native birds as well as to mammals. This, however, is but an accident in the carrying out of a policy ; it is of greater moment that the policy itself may be at fault. In September, Science Service (Washington, D.C.) reported from Ann Arbor some of the results of an investigation carried out by Dr. Ned Dearborn, of the School of Forestry and Conservation in the University of Michigan, into the food of nine predatory animals generally reputed to be harmful to farm stock or game birds and

animals — fox, skunk, weasel, mink, 'wild cat' (lynx), opossum, raccoon, coyote and badger. For two years the food habits of these creatures have been studied, 3,000 specimens of stomach-contents have been examined, and the result suggests that the ordinary judgments usually wrong the predator. The skunk, for example, gains more than 57 per cent of its diet from insects, while birds comprise only 2·35 and eggs 0·11 per cent.

The fox, to take even a more striking example, is looked upon as the arch-enemy of the hen roost and of game birds, but according to these studies in Michigan, its food in 1931 consisted of 91 per cent mammals, of which rabbits and hares made up 81 per cent, followed, in order, by mice, rats, squirrels, deer, moles and shrews. Of the remaining 9 per cent of the total, 3·42 was insect food, 3·64 wild fruits, and only 1·12 per cent birds. In the 1930 collections, bird and egg delicacies formed a greater share of the diet, with 11 per cent. Similar results were found with regard to the other creatures tested: the larger part of their animal diet was made up of rabbits, supplemented by rats, field-mice, moles and shrews.

Dr. Dearborn holds that flesh-eating and plant-eating animals must complement one another: predators through the ages have killed off weak herbivores, thus building up strong strains, while, on the other hand, alert herbivores escape and starve out weak predators. Man upsets this balance and then tends to lay the blame on the animal group which seems to him least desirable.

With what unexpected and contrary results interference may be repaid was well shown by Mr. M. A. C. Hinton in a valuable paper on the biological principles of the control of destructive animals, recently read before the Linnean Society of London (*Proc. Linn. Soc. London*, pt. 4, p. 111, 1931–32). Two examples will illustrate his point.

The mountain lion (*Felis cougar*), once widely distributed in the United States, has been killed off until it is now represented by very few individuals. In the Kaibab National Park, in the Grand Cañon district, it has been practically exterminated, with the result that deer, deprived of their natural enemy, have multiplied without check. In 1924 there were 30,000 of them, more than the area could support; when the grass had been eaten and trees had been bared as far as the deer could reach, the animals starved. Although the numbers have now been somewhat reduced, vegetation even yet can make no headway against their depredations. Instead of protecting the deer, the slaughter of the mountain lion threatens their existence. Starvation, coupled with inactivity and over-breeding, Mr. Hinton points out, have sapped the strength of the deer, so that they may fall before the first epidemic disease or first bad year they encounter, and also suffer extermination.

The story of the rivalry in Great Britain between the old black or ship rat and the brown or Norwegian rat is well known. Neither could have survived in its hordes had we not provided it with food and shelter, and at the same time destroyed its natural enemies. But the brown rat, more hardy and robust, on its arrival in Great Britain in the early part of the eighteenth century, quietly wiped out the black rat, which since has been able only to found sporadic colonies, generally in the neighbourhood of sea-ports. By strenuous efforts, enforced by legislation and stimulated by anti-rat propaganda, the brown rat is now being ousted from many places which it used to frequent. New buildings are rat-proof from the start, old buildings are being made rat-proof.

'Brown-rat-proof' one ought to say, for Mr. Hinton reminds us that while concentrating on the destruction of the brown rat, we have been forgetting the black rat which it kept in check. His description is well worth quoting, as a warning and as a vivid picture of unlooked-for consequences. "We have shut the rival out, established lovely attractive kitchens on the roofs fitted with plenty of nice open sky-lights, and we have linked up roof and roof, and bridged the horrid streets with a lovely network of telephone wires and cables. No primitively arboreal species could imagine a nearer approach to paradise. Every night there is a procession along these cables and over the roofs; new colonies are established in every possible place. *R. rattus* [the black rat] is now once more the Common Rat in many parts of our great city. To show how quickly it works: Bankers move in to a brand-new building on Monday; on Wednesday they think they have rats. During the week-end the backs are eaten off many of the new books, and on the following Wednesday the rat-catcher takes more than sixty out of the up-to-date roof-kitchen. We are thus fast getting back to the state of affairs which existed in the seventeenth century not only in London, but in many other of the larger ports. If this goes on we shall certainly be once more in peril of plague."

It is the old story that is ever new. J. R.

A New Philosophy of Biology

Grundzüge einer allgemeinen Biologie: die Organismen als Gefüge-Getriebe, als Normen und als erlebende Subjekte. Von Prof. Dr. Richard Woltereck. Pp. xvi + 629. (Stuttgart: Ferdinand Enke, 1932.) 40 gold marks.

PROF. WOLTERECK'S ponderous volume contains, in our opinion, a work of fundamental importance which we earnestly recommend to the attention of readers of NATURE. True to the thoroughness characteristic of his countrymen, the author has examined the problem of life from all its aspects, psychological as well as physiological, and has come to far-reaching conclusions with many of which we agree. It is greatly to be desired that the book should find a translator; but when he is found we do not envy him his task: for the author has followed the custom of German philosophers and has expressed his views in a complex syntax with many dependent clauses the unravelling of which in many cases is like making out a puzzle.

Within the compass of a review of manageable length it is impossible to give a general account of the line of argument pursued in the book; all we can do is to select certain outstanding features of Prof. Woltereck's position and discuss them.

The first thing to be noted is that the author is an uncompromising vitalist. He does not believe that it is possible to explain *any* of the phenomena of life as the workings of a machine; that is, as the result of an arrangement of unlike substances or parts in fixed relations to each other. Always, he maintains, between the beginning and end of an action there intervenes the unseen regulating vital factor.

In the view of the circumstance that vitalism has been denounced as obscurantism by high scientific authority in Britain and is supposed to be confined to systematists and morphologists, it may be interesting to notice that Woltereck is the third great German biologist to pass from materialism to vitalism; and according to what he says in his preface it required twenty years for him to make the passage. The first biologist to pass over was Driesch; the second Uexküll, and none of the three could be described as either a systematist or a morphologist. Driesch laid the foundation of the great science of experimental embryology; the core of his work remains unshaken until the present time and none of his arguments has been successfully answered. Uexküll in his epoch-making work on Echinoderm physiology anticipated by twenty years discoveries in muscle physiology, which when they were rediscovered by human physiologists, excited the greatest interest and astonishment.

Woltereck's great scientific achievements may not be so familiar to non-zoological biologists, and therefore a brief notice of them may be inserted here. He worked out in minute detail the embryology of the primitive Annelid *Polygordius* and laid the foundation for our understanding of the meaning of the trochophore larva. He showed that this larva has at the beginning of its development a radial structure which is fundamentally that of a primitive Ctenophore, and he gave a suggestive theory as to the manner in which this Ctenophore ultimately became a worm. His work is comparable in importance with Sedgwick's description of the embryology of *Peripatus*. Of late years Woltereck has devoted his attention to the experimental modification of development and has chosen for his subject the minute crustaceans belonging to the group Cladocera (*Daphnia* and its allies) and he has proved up to the hilt the inheritability of induced modifications—in plain language, acquired characters. Some of his experiments, such as transplanting a German strain to Lake Nemi in Italy, have lasted twenty years.

The fact is that, when we think the matter out, vitalism is not obscurantism but commonsense. For as Woltereck insists, we must begin our analysis not with matter but with experience, because matter is only a name for 'our' interpretation of part of this experience which is presented to 'us'. In a word, there is no such thing as experience *in vacuo*; it is always the experience of some one; and this knowledge of our own life, which is immediate and certain, is the safest guide to the real nature of the life of other beings. So Woltereck is driven to the conclusion that there is something, however dim and rudimentary, analogous to feeling even in plants.

Woltereck endeavours to show that in its final analysis life can be reduced to a series of 'impulses' or strivings. These impulses may be 'answers' to something in the environment, or they may be autogenous, the latter term referring especially to the successive impulses which carry development from the egg to the adult form. But all these 'impulses' show the same fundamental character. They are directed to the

attainment of an 'end', and if prevented from reaching this end in one way they will seek it in another. This is seen equally when a Stentor seeks to avoid an irritating shower of chalk particles by sweeping them away by ciliary action, then by bending its head to one side, and finally by swimming away, as by a distorted egg constructing the future embryo out of totally different materials from what it would have used if left undisturbed.

When he comes to consider the question of racial evolution, Woltereck is scathing in his references to 'natural selection'. He says that the doctrine that the orderly growth of one species into another can be explained by 'chance' variations, has produced some of the most curious mental aberrations in the history of psychology. On the subject of 'mutations' he takes up what seems to us a perfectly sound position: he says that ninety per cent of them are pathological (we should have said a hundred per cent), that they deal with 'additive' characters which do not affect the real constitution of the organism and have therefore had nothing to do with racial change. He is inclined, we think, to take the crude conceptions of the Morgan school as to the 'genes' being in the chromosomes too seriously, even admitting their identification with the 'chromioles' seen in stained preparations, but he insists that the hereditary substance is not made up of genes (therein the late Dr. Bateson would have agreed with him): these he regards, like hormones, as secretions of this substance which have certain definite effects.

When Woltereck considers the Lamarckian theory of evolution, it is clear that he does not really understand what that theory is, and that many of his difficulties would have disappeared if he had grasped its meaning. He refers to the theory as the "direct influence of the environment" and asks if it be a real explanation of evolution why in a uniform environment there should be such a varied fauna. His own experiments on the inheritance of induced modifications he discounts, because the altered progeny when returned to the original conditions, slowly through a considerable number of generations, reverted to the typical form.

Now if there is one thing on which Lamarck insisted it was that the environment exercised *no direct influence on the organism whatever*: it caused, however, the animal to adopt new habits; and it was the exercise of these habits which modified structure. Woltereck mentions the case of the perch-like fish, the *Cichlidæ*, in Lake Tanganyika, all of which seem to be modifications of one or at most two ancestral species introduced into the lake but which now are divisible into many species. This case has been studied in detail by Dr. Tate Regan, and he has shown that the cause of the differentiation of these species is the different kinds of food which they have selected and the various ways in which they seek it; in a word, their habits. Mr. Hinton, keeper of mammals in the Natural History Museum, has mentioned a case where three different species of rodent with different colours of fur inhabit the same burrow in the arid parts of Syria. Here is a case which seems to prove that colour is independent of environment until it is discovered that one species is diurnal, one nocturnal, and the third crepuscular, in its habits.

Coming now to the reversion of induced modifications to type when replaced in the typical environment, which Woltereck (and also Przibram) considers as a bar to regarding them as the real producers of new species, two things are forgotten; namely, (1) that this is what was to be expected, (2) time. For if change in environment will modify organisms in one direction a change back again will tend to modify them in the opposite direction; but the longer a habit has been exercised and the more deeply it has affected structure, the more it will resist modification; and the changes in habit embodied in specific distinctions are very old things. Lamarck with prophetic insight insisted on the importance of time in his theory of evolution, asserting that only habits which had persisted *a long time* had an effect on structure. It is significant, as Woltereck informs us, that at the Congress on Hereditary Science, held in Germany in 1929, practically all the palæontologists adopted a Lamarckian position.

Woltereck does himself less than justice when he suggests that Lamarckian evolution may have played a part in the formation of species within a phylum, but that for the start of a new phylum a sudden beginning—a new 'mutation'—must be assumed. For his own work on the trochophore has enabled us to connect together such diverse groups as the Annelida, the Mollusca, the Rotifera and the Polyzoa, and to show that they are all descendants of the same ancestral group and to discover the changes in *habits* which led to the original separation of two different phyla. Such an event was at first slight in itself but led in the course of ages to such momentous consequences,

and such a fundamental cleavage in structure, that even first-rate biologists like Woltereck are deluded into supposing that the cleavage must have commenced with a miracle.

To the invocation of 'mutations' as explanations of radical differences, we are fundamentally opposed because this method of dealing with difficulties seems to us mere indolence of thought. Does an embryologist discover in some member of a vertebrate family a very aberrant type of development? It is not clear to him how it originated; therefore it must be due to a 'mutation'. Does a botanist discover on the top of a mountain an aberrant species of a genus other species of which flourish on the lower slopes? What is easier than to explain the new species as due to a 'local mutation'? In fact, the mutation is used exactly as the 'joker' is employed in the games of euchre and coon-can to supply the place of any card needed to complete the trick. Subsequent research has shown that the supposed 'local mutation' is found on other mountain tops and is in fact the remains of a northern species finding its last retreat on the cooler heights, and we have no doubt that in time a satisfying explanation will be found for the aberrant type of development.

The vitalistic views of Woltereck will certainly awaken the most determined opposition on the part of many biologists, but in our opinion these views constitute a valuable contribution to biological science. Opponents of vitalism fall into two groups. There are first out-and-out materialists, or, as it is now the fashion to call them, 'mechanists', who believe that matter and energy are the sole realities in the universe. To discuss the difficulties of this position would lead us too far; it is sufficient to notice that it was emphatically repudiated, at any rate in his later days, by T. H. Huxley. But there is a second and more moderate group which, whilst admitting that there may be a non-mechanical factor in all living things, think that the only scientific method of approach is to treat them *as if* they were mere masses of carbon compounds and to endeavour to explain their activities as outcomes of their chemical composition. The legitimacy of this view is beyond question; its value will be determined by its success in practice, but to our mind it is like attempting to solve an equation whilst completely disregarding one of the unknowns. In this way at best only a partial solution could be hoped for, and it is significant that so far along this road no complete solution of even the simplest living phenomenon has been attained. In fact, as Prof. J. S. Haldane has remarked, the failure has been colossal. When we approach the problem of development even the faintest semblance of an explanation on mechanistic lines becomes impossible, and it was this circumstance that originally converted Driesch to vitalism. If instead of dismissing the unknown factor, as a mysterious entelechy, which was the procedure adopted by Driesch, we endeavour with Woltereck to come to some understanding of the laws of its action, a distinct advance will have been attained.

Let us conclude by giving one example of this latter procedure, admirably described by Woltereck. A young Radiolarian, he remarks, is a mere sphere of clear protoplasm containing a central nucleus. From its periphery stream out delicate interlacing strands of almost fluid protoplasm. As the Protozoon grows older, delicate needles of silica, each adorned with characteristic outgrowths, sprout out from it, until in the end a series of concentric baskets of silica may result. The shape, branching and arrangement of these needles is a fixed specific character. They are laid down, however, by fluid strands of protoplasm. To what is this fixity of pattern due? Certainly not to the arrangement of molecules in the protoplasm, for these are constantly rolling over each other like the molecules of any other fluid. Woltereck, like some other leading German biologists, is driven to the assumption of a 'biological field', which like a magnetic field compels particles entering it to arrange themselves in certain definite patterns. The biological field itself is due to an influence radiating from a centre, presumably the nucleus, but it cannot be explained on mechanistic lines. In Woltereck's opinion, the production of these fields is the mode by which the vitalistic activity present in the ovum ultimately builds up the adult body. To sum up, vitalism regards an organism primarily not as a substance but as an activity; and the activity to a considerable extent controls the constitution of the substance.

As we finish this review we are painfully conscious of its inadequacy and of the numerous profound thoughts in Woltereck's book which it has been impossible to mention. To do justice to these would require a treatise rather than a review. If what we have written induces readers of NATURE to become acquainted with Woltereck's book themselves we shall be satisfied.

E. W. MACBRIDE.

Algebraic Plane Curves

A Treatise on Algebraic Plane Curves. By Prof. J. L. Coolidge. Pp. xxiv + 513. (Oxford: Clarendon Press; London: Oxford University Press, 1931.) 30*s*. net.

THERE was a time, not so very long ago, when the words geometry and mathematics were almost synonymous. To-day the pure mathematicians, in every country except one, are nearly always analysts; even the minority who still call themselves geometers generally occupy themselves with some of the differential aspects, avoiding diagrams and filling their pages with symbols, as if they felt that their continued existence depended upon conforming as much as possible to the fashions prescribed by the all-powerful analysts. But we need not despair; rare animals have been saved from extinction by measures of protection taken just in time, and now Prof. J. L. Coolidge comes to the assistance of algebraic geometers with a book written in the spirit of and dedicated to the geometers of Italy, the only land in which they still flourish.

There is a great need for such a book, for Salmon's great work has long been obsolete, belonging to an age that knew nothing of Nöther's fundamental theorem and was content with a naïve process of counting constants. Recent English books give a good account of curves of the third and fourth order or other special topics, but they have very little about general theorems. Perhaps the best account of general methods is given in Severi-Löffler's "Vorlesungen über algebraische Geometrie", but this omits many important parts of the theory, and Severi's "Geometria algebraica" has as yet reached only its first volume.

Prof. Coolidge's treatment is very extensive, so far as the general theory is concerned. His only important omissions are just those special topics which are readily accessible elsewhere. It is useless to look here for the properties of the bitangents of a quartic, but there is something about curves classified by their genus, such as rational curves, elliptic curves, and so forth. The emphasis is on Nöther's theorem (now the foundation of the subject), Plücker's equations, Cremona transformations, and the theory of correspondences (treated in a special case by Chasles, discovered intuitively by Cayley, and first proved by Brill). A useful feature is the inclusion of a brief treatment of invariants, including the Aronhold symbolic notation, which is used later in dealing with apolarity. The notation of the tensor calculus is also used, though not very often.

In studying linear series of point-groups on a curve, much use is made of Abelian integrals, the leading properties of which are briefly explained. At this point the analysts will chuckle. There seems no reason why algebraic geometers should not be able to work out all about algebraic correspondences by strictly algebraic methods, but the melancholy fact is that they cannot; and up to the present they continue to upset the already unfavourable balance of trade between geometry and analysis by importing devices foreign to their subject, such as Abelian integrals.

There are a few minor points upon which the book seems open to criticism. The frequent avoidance of homogeneous co-ordinates by using unity as a variable and differentiating with respect to it is admitted to be "rather bizarre" (p. 7) and a "curious trick" (p. 12). The definition of circular points at infinity (p. 14) appears artificial, and moreover contains an unfortunate misprint which may puzzle a beginner. The treatment of asymptotes could have been improved. But on the whole, the book will be of great use to students in providing a source, perhaps the only accessible source, of a subject which, though at present unfashionable, must remain one of the "invariants, matters of abiding interest and importance, which deserve to be always held in honour".

H. T. H. PIAGGIO.

Ethnology of Mysore

The Mysore Tribes and Castes. By the late H. V. Nanjundayya and Rao Bahadur L. K. Ananthakrishna Iyer. Vol. 4: K–V. Pp. x + 677 + 68 plates. (Published under the auspices of the Mysore University.) (Bangalore: Mysore Government Press, 1932.) 12.8 rupees; 20*s*.

MR. ANANTHAKRISHNA IYER and his late colleague have now supplied us with the third of the four volumes in which the castes and tribes of Mysore are described on the lines laid down in 1902 for the Ethnographic Survey of India. The first volume, which is to be issued last and will summarise the contents of the other three, will be awaited with special interest.

The present volume presents two specially noteworthy features. It contains an account of the Lingāyats, that un-Brahmanic Hindu community numbering many millions which presents the remarkable aspect of a reform movement starting on

a non-caste basis and gradually succumbing to the caste prejudices of the later converts. Panchamsalis with the full eightfold sacraments, non-Panchamsalis with the same privileges, and the lower orders without these rites roughly represent the Virashaiva community in its present-day form.

The compiler of this volume has drawn copiously on an article in Hastings' "Dictionary of Religion and Ethics" for his materials. The value of the account would have been greatly increased by some mention of the sub-divisions of Mysore Lingāyats on the lines of those given in "Tribes and Castes of Bombay". A similar omission may be noted from the article on Musalmans. The author of this work is to be congratulated on the new and valuable materials given in the articles on Kurubas, Madigas, Morasu Okkalu, Nayinda, Sadaru, Oddars, and Uppars, which bring to notice the important exogamous sections known as *bedagus*, which are equivalent to the well-known Marātha *devaks*. Some novel and suggestive trees, plants, and animals will be found in these lists, which are the real indication of the origin of such social elements, however these may be hidden in popular tradition.

The compiler of the work, who has quoted somewhat lavishly from published accounts of Marāthas, might have added some original matter describing the Marātha *devaks* found in Mysore, as a contribution to the subject. The article on Kurubas is perhaps one of the most informative in the volume. There seems to be a close parallel, suggesting more than mere resemblance, between the Kāla Kunbi (or Kare Vakkal) of the Bombay Presidency and these Kurubas of Mysore. The costume of the women is strikingly similar, and there are many other points of contact.

A number of excellent illustrations exhibit typical specimens of the types described in the work. Unfortunately, one of the best, the Sanyāsis (p. 571), has suffered much in reproduction.

The criticism that has so frequently to be passed on works of this nature produced in India, and which has been applied to the two previous volumes of this series, is a want of care in revising proofs, resulting in misspellings and varying forms of the same word which might easily be avoided and do much to disfigure the pages. In spite of six errata, an incorrect version of the name of the author of "Tribes and Castes of Bombay" has remained uncorrected (p. 476). We find such curious slips as Myroba jam (p. 277) for the well-known myrabolam or *hirda*, and *manganefera* for the *mangifera* or mango. Okkalu is spelt in four different ways.

The assistance of well-known works on Indian trees and shrubs might well have been invoked to enable the writer to give the botanical equivalents of the numerous terms mentioned in the vernacular for the totem articles, which are of great importance. In India, with its wealth of languages, the work of comparison of these useful lists is only possible if the common botanical equivalent is shown against the local designation. The *ari* or *benni*, for example, is not readily identifiable with the *apta* unless it is shown as *Bauhinia racemosa*. Similarly, we do not connect the *muttaga* with the *palas* unless we are told that it is the *Butea frondosa*. The *nagare* and *kare* lack the revealing *Calophyllum tomentosum* and *Diospyros assinilis* which would expose their identity to the general reader.

With these remarks, relating to small defects that could readily have been avoided, this notice may be brought suitably to an end by acknowledging very cordially the debt that students of ethnology owe to the University of Mysore and Rao Bahadur Ananthakrishna Iyer for the three important volumes of which the present is the conclusion. Such works pave the way to a further and much-needed undertaking. This should deal, on the basis of published materials, with the tribes and castes of India taken as a whole, rising above the limitations inseparable from the artificial restrictions of provincial and State boundaries. It is to be hoped that such a work may be put in hand before it is too late. R. E. E.

Short Reviews

(1) *Heimskringla: or the Lives of the Norse Kings.* By Snorre Sturlason. Edited with Notes by Erling Monsen and translated into English with the assistance of A. H. Smith. Pp. xxxviii + 770 + 12 plates. (Cambridge: W. Heffer and Sons, Ltd., 1932.) 18*s*. net.

(2) *The Culture of the Teutons.* By Prof. Vilhelm Grönbech. (Published at the expense of the Rask-Ørsted Fund.) Translated into English from "Vor Folkeæt i Oldtiden", I–IV., Copenhagen, 1909–12, by W. Worster. Vol. 1. Pp. v + 382. Vol. 2. Pp. 340 + 142. (London: Oxford University Press; Copenhagen: Jespersen og Pios Forlag, 1932.) 30*s*. net.

(1) "HEIMSKRINGLA", the history of the Norse kings compiled by Snorre Sturlason, of Iceland, probably only a few years before his death in 1241, is a historical document of the first importance. Not only does it give a vivid picture of the culture and society of early Scandinavia, but also it has value as a record of the racial movement from the north which harried medieval Europe, written from the point of view of the raiders themselves. Moreover, it covers the voyages of the Norsemen

to Greenland and the discovery of Winland, that is, some part of the American mainland, although the chapters in the narrative which deal with the voyage of Leif Ericson have been held under suspicion as an interpolation. With this judgment, however, the present editor does not agree. The Ynglinga Saga dealing with events up to the birth of Halvdan the Black in 820, where Snorre's more detailed history of the Norse kings begins, gives a view of paganism and the early history of Scandinavia which is distinctly individual among early chronicles in its attitude to such matters.

Students will be grateful for this translation, in which style and language are happily adapted to the subject-matter. The editor has provided an introduction which deals with the life and writings of the author, the manuscripts, the Norse kings and the Nordic races, the Danes in England, and cognate matters. He also annotates the text.

(2) "The Culture of the Teutons", a translation of a work by the professor of the history of religion in the University of Copenhagen, might almost be termed a psychological handbook to the early literature of Scandinavia and Iceland. Although it refers to Anglo-Saxon, Burgundian and Lombard, as well as the Germanic tribes, it is concerned mainly with the Norsemen. Institutions are analysed in detail on the basis of the indications afforded by the literature, but with reference to their psychological content rather than their form. In other words, the author aims at a reconstruction of Norse society from the point of view of the Norsemen themselves. As he points out, the reader of the epics and sagas enters upon a new world which is open to misinterpretation if regarded from the modern point of view. The book is a valuable contribution to a study of many obscurities, and a translation into English is welcome.

Probleme der Wasserwellen. Von Dr. H. Thorade. (Probleme der kosmischen Physik, herausgegeben von Prof. Dr. Christian Jensen und Prof. Dr. Arnold Schwassmann, Band 13–14.) Pp. viii + 219 + 11 Tafeln. (Hamburg: Henri Grand, 1931.) 20 gold marks.

ALTHOUGH it is usual, in expounding the elements of wave motion, to refer to water waves as examples, there is probably far less known of the behaviour of real waves on water than there is of the behaviour of waves of light or sound. The study of both the experimental and theoretical aspect of, for example, ocean waves, or of the generation of waves by wind, encounters formidable difficulties, and the complexities of tidal problems are well known. From the time of Scott Russell to the present day labours of, among others, Proudman and Havelock, the subject of water waves has received substantial contributions from British men of science, and there will probably be many British readers who will welcome Dr. Thorade's book, which appears as Nos. 13 and 14 of the series "Probleme der Kosmischen Physik", edited by Profs. Christian Jensen and Arnold Schwassmann.

While the book outlines the methods and results of the chief mathematical investigations, including the most recent, it is free from detailed mathematical expositions, for which the reader is referred to the standard textbooks, such as that of Lamb, and to the original papers, of which there is an extensive bibliography. It gives a very good and clear account of tidal waves and surface waves in their many aspects, and a discussion of what is known of their mechanism, with special reference to outstanding problems. Particular mention must be made of the many diagrams, excellent alike in planning and execution, which help considerably with the discussion. There are, in addition, five beautiful photographs reproduced as plates. Many physicists with no specialised knowledge of water waves will find the volume of great interest.

Nature Photography. By Oliver G. Pike. With Chapters on Big-game Photography, by Major Radclyffe Dugmore; Marine Photography and Low-power Microscopy, by F. Martin-Duncan; Photography of Plant Life, by E. J. Bedford. Pp. xii + 196 + 53 plates. (London: Chapman and Hall, Ltd., 1931.) 12*s*. 6*d*. net.

WITH the coming of the cinematograph and the large aperture lens, and with the great improvement in the quality of telephoto lenses, Nature photography has made such strides that excellent photographs of pre-War days seem childish beside the modern product. There are many who would follow the new technique did they know how, and to them the revelations in this book will be welcome and helpful. There are hints on cameras and lenses, on the construction of 'hides' and methods of approach, on cinematograph work, special chapters by experts on big-game, marine and plant photography and on low-power microscopy, accompanied by illustrations of the art and an anecdotal narrative that makes the book good reading for the field-naturalist as well as for the Nature photographer proper.

Flotation Plant Practice. By Philip Rabone. Pp. xi + 141. (London: Mining Publications, Ltd., 1932.) 10*s*. 6*d*.

MANY physicists interested in the application of physics to industry will welcome the appearance of a work dealing with flotation practice which is not so detailed as to be burdensome, and is yet full enough to come down to such practical details as costings. Mr. Rabone's book deals, in less than 150 pages, with such topics as crushing; grinding; flotation reagents, machines and methods; and concentrate and tailing disposals. He has found space to devote a few pages to the theory of the method, and although he remarks that some may think that his treatment of the theory of flotation "is more extended than the scope of the book warrants", this section could certainly be expanded with advantage.

The book is compact in size, well produced and illustrated, and may be recommended. A. F.

The Internal Photoelectric Effect in Crystals

By A. H. WILSON, Cavendish Laboratory, Cambridge

THE extensive work of Gudden, Pohl and others has to a certain extent clarified the behaviour of insulating crystals which become electrical conductors under the influence of light. In these substances the photo-conductivity is entirely electronic, and we leave out of consideration electrolytic processes in which massive ions transport the current. Crystals can in the main be divided into two groups—idiochromatic crystals which are photosensitive in the pure state, and allochromatic crystals which only become photosensitive after being treated with X-rays, or which owe their sensitiveness to the presence of impurities. It has so far proved impossible to correlate these complicated photo-effects with the theory of the solid state, but in view of the recent advances in the theory of poor conductors and of the influence of impurities on conductivity,[1] it seems worth while to see if any unification is now possible.

If we examine the possible types of photo-effect which can take place in what we believe to be a fairly correct model of an insulator, we find that we are able to explain a large part of the phenomenon known as the primary photo-electric current, which is that part of the current which is proportional to the intensity of the light. The explanation offered here is similar in many respects to the explanations put forward during the past decade by Gudden and Pohl, and may be considered as a justification of their main hypotheses. In what follows, the theoretical principles which govern the photo-conductivity will be outlined only, no attempt being made to discuss the subsidiary phenomena. A good account of the experimental results will be found in a recent article by F. C. Nix.[2]

It is now well known that the energy spectrum of an electron moving in a perfect lattice splits up into bands of allowed and disallowed energies, and if there are just sufficient electrons present to fill up one of the allowed bands, there can be no conductivity at absolute zero temperature. Further, if an electron is placed by any process in an unoccupied band, it becomes a 'free electron', and again, if there are not quite enough electrons present to occupy a band fully, then the resulting 'holes' are free to move through the crystal, and behave like free electrons with positive charge. In an insulator in the pure state, there are just sufficient electrons present to fill up one of the bands, and any conductivity is due to the presence of impurities, or has been produced artificially by electron bombardment or by the action of light. We consider as a typical allochromatic insulator sodium chloride, and for simplicity restrict ourselves to a one-dimensional lattice of n sodium atoms and n chlorine atoms arranged alternately. We further idealise the problem by leaving out of account all the electrons except one of every atom, and we therefore have $2n$ electrons to deal with. Since the sodium chloride crystal is an ionic one, the highest occupied band belongs to the chlorine atoms, and the motion of an electron in this band represents an electron jumping from one chlorine to another. This 'chlorine band' contains n energy levels, equal to the number of chlorine atoms present, and these energy levels will just accommodate the $2n$ electrons, since according to Pauli's principle not more than two electrons can ever occupy the same energy level.

When a quantum of short wave light is absorbed to sensitise the crystal, its effect is to transfer an electron from a chlorine to a sodium atom. In this state the crystal is not conducting, and so

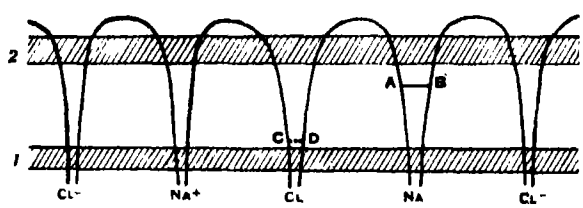

FIG. 1.

we must assume that the electron has not been excited into a band of the crystal but into a discrete energy level. The correct way of describing the crystal when it is in this sensitised state is to say that it is built up of $(n - 1)$ positive sodium ions and $(n - 1)$ negative chlorine ions in which are imbedded two impurities, a neutral sodium and a neutral chlorine. The energy levels of this system are illustrated in Fig. 1. The potential energy of an electron is drawn, and the shaded band 1 represents the chlorine band which is fully occupied, while the band 2 represents the lowest unoccupied band. Although the neutral chlorine and sodium are drawn as neighbours, it is not implied that this is necessarily so in an actual crystal.

The band 1 has $(n - 1)$ energy levels, and these will just accommodate the $2(n - 1)$ electrons belonging to the ions. The neutral sodium and chlorine have the remaining two electrons in discrete states. The energy level of the electron on the sodium is represented by AB, and the energy level of the 'hole' caused by the removal of the electron from the chlorine ion is represented by CD. The whole crystal is non-conducting provided the energy level AB lies below the band 2, and provided CD lies above 1. In thinking of these bands, it is essential to remember that they are energy bands, and not localised in space, so

that we have drawn band 1 crossing both the sodiums and the chlorines, although it is a chlorine band. Only the discrete states can be thought of as belonging to one particular atom. The crystal in this excited state cannot be stable, but since in some cases, of which rock salt is an example, it can exist for years, it must be in a metastable state. Since any electron from the band 1 of the original crystal may be excited into a state such as AB, the absorption of light is continuous over a range of frequencies corresponding to the width of the band 1. The continuous absorption is therefore due to the initial state belonging to a continuum and the final state being a discrete one, whereas in atoms and molecules it is the final state which belongs to a continuum. In rock salt the absorption which sensitises the crystal takes place in the ultra-violet and X-ray regions, though in the silver halides the absorption extends into the visible.

If the crystal is now placed in an electric field and illuminated with light of such a wave-length that the electron in the state AB is ejected into the band 2, a current will be observed, and this constitutes what is known as the primary negative current. A new absorption band has therefore been introduced into the crystal at a wave-length which is usually considerably longer than that of the light required to sensitise the crystal. In rock salt this absorption takes place in the yellow. After the negative current has ceased to flow, we are left with a lattice in which there are n sodium ions, $(n - 1)$ chlorine ions and one neutral chlorine atom, among which are to be divided the $(2n - 1)$ electrons. Of these electrons, $2(n - 1)$ are just sufficient to fill the band belonging to the chlorine ions, and the remaining one is attached to the chlorine atom in a discrete state, so that the crystal is once more non-conducting.

This is not the only possible state of the system. Another possible configuration is that in which there are n positive sodium ions, and n exactly similar chlorine ions with $(2n - 1)$ electrons distributed among them. In this configuration the crystal would be conducting, the conductivity being caused by the vacancy in the shell of electrons forming the chlorine band, and this 'hole' behaves like a positive electron. In rock salt this state of the crystal has greater energy than that in which one of the chlorines is neutral, and we may represent the state of affairs schematically by saying that the neutral chlorine atom has a vacant energy level CD, which can take up an electron from the band 1 if an amount of energy is supplied represented by the difference in energy between CD and the band 2. This energy may be supplied by illumination with infra-red light, or by heating, in which case the energy is supplied by the lattice vibrations.

Provided the temperature is low enough, it is possible to keep the crystal in the non-conducting state for a long time, and to let it pass over slowly into the conducting state, thereby separating out the positive current from the negative current, which appears immediately the crystal is illuminated. Gudden and Pohl ascribe the possibility of this separation to the sluggishness with which the 'holes' move through the crystal. According to the present theory, the 'holes' in a band can move through the lattice as quickly or nearly as quickly as the free electrons, and the sluggishness of the positive current is due to the slowness of the change from a non-conducting lattice with a neutral chlorine imbedded in negative chlorines to a conducting lattice in which all the chlorines are on the same footing.

It might quite well happen that the state AB does not lie below the band 2, but actually in it. In this case AB can no longer be thought of as being discrete, but belongs to the band 2. The electron on being removed from band 1 immediately becomes a free electron, which is the characteristic of an idiochromatic crystal, a typical example being diamond. In diamond the configuration of the crystal with lowest energy, after an electron has been ejected, seems to be made up of a positively charged carbon atom imbedded in neutral carbons, and the 'hole' which is left therefore corresponds to a discrete state of exactly the same nature as CD in Fig. 1. So for diamond, as for rock salt, the negative and the positive currents can be separated. In order to bring the diamond into a state in which a positive current can flow, it is necessary to supply energy in the form of infra-red light or heat, and then the crystal passes over into the state in which all the carbon atoms are on the same footing, and in which there are not quite enough electrons to fill up a band.

A further possibility is that, when an electron is ejected from the band 1, the state of lowest energy is that in which all the atoms are on the same footing. In this case the positive and negative currents must flow simultaneously, and there would be no possibility of separating them. This case would be represented by the level CD lying below the top of the band 1, a state of affairs which seems to be realised for sulphur. The 'hole' cannot then be considered as being attached to any particular atom. However, it should be borne in mind that the conducting state may merely have lower *free energy* than the non-conducting state, and that at very low temperatures sulphur might behave in the same way as diamond.

We may conclude from the above discussion that the theory reproduces quite naturally many of the most striking features of the internal photo-effect, and that there is no essential difference between idio- and allochromatic crystals, or between those in which the negative and positive currents can be separated and those in which they cannot. The criterion for distinguishing the various cases is whether an electron in a pure insulator goes into a discrete state such as AB on absorbing light or into a band such as 2, and whether the resulting 'hole' corresponds to a discrete state such as CD or whether the 'hole' lies in the band 1.

It must, however, be admitted that there are still many puzzling features of the primary current. In allochromatic crystals the photoelectric response and the absorption of light correspond very well, but in idiochromatic crystals the photoelectric response has a maximum near the long wave edge of the absorption band and falls off very rapidly in the interior of the band where the absorption is large. It therefore seems that, when the absorption is large, there is no conductivity (the absorption of the light which produces the photo-effect in allochromatic crystals is always small). This seems to mean that, when many electrons are excited in say diamond, they go into discrete states and not into a band. One can see vaguely that, when many atoms have electrons excited, the original classification of states into bands, based on the properties of a perfect lattice, is likely to break down, and to be replaced by a classification based on the properties of the individual atoms, but such an explanation cannot be considered as satisfactory. This and many other problems must await further developments of the theory before they can be tackled successfully.

[1] A. H. Wilson, *Proc. Roy. Soc.*, A, **133**, 458; 1931: and **134**, 277; 1931.
[2] *Reviews of Modern Physics*, **4**, 723; 1932.

Hormones and Evolution

By J. T. CUNNINGHAM

ACCORDING to the most advanced results of genetical research, evolution is to be investigated by statistical and mathematical methods. The researches and conclusions of the geneticists are governed by the conceptions of species and divergence. It is obvious that the production of the many varieties of rabbits, dogs, and other mammals, and of birds, under domestication, to say nothing of plants, is an example of evolution; and it may possibly be to a great degree, if not entirely, explained by random mutation and survival. But the geneticists ignore many other phenomena which are equally or more important than the origin of varieties or species, especially the phenomena of adaptation. They regard survival as equivalent to selection, but that term as used by them means usually indirect selection. The survival is attributed to greater viability or fecundity, not to the utility of diagnostic characters. Genetics include extraordinary discoveries concerning sex-linkage, but almost nothing about sex-limited characters, which are known to be inherited by both sexes but developed exclusively or to a greater degree in one.

The doctrine of genes appears to be satisfactory in relation to variation and the origin of varieties and species, but it fails to explain adaptive evolution. When we consider the origin of terrestrial from aquatic vertebrates, the various adaptations of limbs to flight in birds, mammals, and some extinct reptiles, the reversed adaptation of air-breathing vertebrates to aquatic life, and many other obvious and direct adaptations, it is a truism to say that their development in the individual depends on genes in the nuclei of ova and sperms, but it has not yet been shown that they can be explained by any random mutation of the genes. The difficulty is still greater when we consider metamorphosis. It may be admitted that the metamorphosis of the flat-fish is the result of its genetic constitution, although we do not know precisely how the genes produce the hereditary characters in development. But here we have a change in important structural characters from a symmetrical phase with the median plane vertical to an asymmetrical phase with the median plane horizontal, a change taking place gradually in post-embryonic life and corresponding with the change in the relation of the fish to the direction of light and gravity.

We are asked to believe that this co-relation of structural development with external forces is not due to any effect produced by those forces, but to random mutations in the genes which were independent of the external forces, and the survival of those mutations which had the complex co-relation which we see. If we used the mathematical symbols of which the modern geneticist is so fond, how should we express the probability of the production of such an adaptation by random mutation and selection? The gene theory in this case must assume that every conceivable mutation may occur, including those which determine the change from symmetry to asymmetry in the individual, and that sooner or later each is bound to occur, so that selection is omnipotent. But there is no evidence of the occurrence under experiment or observation of the occurrence, uninfluenced by external conditions, of anything like the distortion of the skull which causes the change in the position of the eyes in the flat-fish, and leaves the symmetry of the anterior and posterior regions of the skull unaffected.

The problem of evolution can be attacked from either end of the ontogeny, from the genes to the development of the characters, or from the characters back through development to the genes. Adaptation does not consist merely in the possession of characters which are supposed to be useful or beautiful like the spots on the back of a beetle or the ocelli in a peacock's tail, but also of the functions of organs and their relation to the organism's

mode of life. One of the most curious phenomena to be explained is the influence of internal secretions or hormones on development and function. In the case of the antlers of stags the exclusive development in the male is due to the hormone secreted by the testes. This is an example of the sex-limitation of organs only indirectly related to the reproductive function. In the female mammal the functional cycles of the accessory reproductive organs which form such a remarkable difference in them from the birds and reptiles, are also controlled by hormones. In 1908 I put forward the theory that the origin of the influence of the testicular hormone on characters limited to the male could be explained by the inheritance of the effects of external stimulation. In the case of the stag, the development of the antlers according to this theory was due to the mechanical stimulation of the periosteum of the frontal bone by blows and friction in the fighting between rival stags, and both this development and its association with the presence of the testicular hormone were transmitted to the reproductive cells or gametes, in modern terminology to the genes. No theory of random mutation originating in the genes affords any reason for the evolution of this peculiar association of the sex-limited character with the internal secretion of the testis.

With regard to the female mammal, I suggested that the origin of the reproductive cycle and its hormonic control could be traced to the retention of the ovum in the oviduct during its development, and the stimulation of the uterine walls by the nutrition and growth of the embryo and by the placenta. Similarly the mammary glands on this theory were primarily due to the mechanical stimulation of the skin by the sucking of the young which led to the hypertrophy of dermal glands. Afterwards it was discovered that the anterior lobe of the pituitary produces one or more hormones which influence œstrus and the formation of corpora lutea in the ovary. Cases of precocious sexual maturity in the human subject have been found associated with tumours of the adrenal body. In order to cover such facts, I extended my theory to all the endocrine organs, postulating that the hypertrophies caused by the developing fœtus were inherited not merely in association with the hormone of the ovary or ovarian follicles, but also in association with the normal hormone complex, so that excess or defect in any one of the more active of these organs caused abnormalities in the sexual cycle: injection of pituitrin, for example, causing formation of corpora lutea, the modification in mammals of the ovarian follicles from which ova have been discharged.

Apparently the secretion of the pituitary is the most active of the hormones not derived from the reproductive system itself, and it has the most marked influence on the ovary in the mammal. But it has no such effect on frogs or oviparous reptiles or birds, although it produces the same secretion in these animals. If the formation of corpora lutea were the effect of gestation, this result at the beginning of the evolution of gestation would occur in association with the presence of pituitrin in the body. If the acquired character were transmitted to the genes it would still be in association with pituitrin, so that injection of the latter would cause the formation of corpora lutea when there was no ovum or fœtus in the uterus. The action of a hormone on this theory suggests an analogy with that of the associated stimulus in a 'conditioned reflex'.

The physiologist finds that the secretion of the pituitary affects the phases of the reproductive cycle, and concludes that the gland goes through a cycle which causes the reproductive cycle. But that is no explanation; the question still remains what causes the pituitary to pass through such a cycle in mammals and other viviparous vertebrates and not in oviparous forms. On the theory that the external stimulation, that is, the presence of the developing ova in the oviduct, was the original cause and that the effects of this were inherited in association with the hormone plexus, we have an explanation, whereas genetics and physiology give none. This extension to the whole hormone complex of my theory of the association of secondary sexual characters and the female sexual cycle in mammals with the hormones of the reproductive organs was communicated to the Second International Congress for Sex Research, held in London in 1930.

Having given so much attention to the subject, I was very much interested in the letter by Prof. Landsborough Thomson on the evolution of hormones published in NATURE of October 8. This is the first discussion by any other biologist than myself, which has come to my notice, of the evolution of the relation between hormones and development, especially with reference to sex-limited characters and accessory reproductive organs. Prof. Thomson naturally uses technical physiological terms which are unfamiliar to other biologists, such as 'integrative mechanism' for the action of one part on another by which the functions of the organs are co-ordinated. He refers to the evidence that some of the chemical linkages have been established by the evolution of a tissue responsive to a substance already present in the organism. He thus agrees with me on the point that the hormones were in existence before the responsive tissues or developments were evolved.

It is therefore not the evolution of the hormones which has to be explained, but the evolution of the response to the hormones. I hope that Prof. Thomson will consider the theoretical suggestions which I have published and agree that external stimulation (regarding the ovum and developing embryo in the oviduct or uterus as really external to the organism) affords a reason for the evolution of the special responses, while the doctrine of random mutation cannot be applied to this case because the obvious association of the new development, whether corpus

luteum, mammary gland, or antlers in the stag, with a new stimulation is inconsistent with the term random.

Prof. Thomson refers to the vestigial survival in the mammal of the substance which causes expansion of chromatophores in Amphibia and teleosts. But is not the fact rather that the pituitary remains the same while the chromatophores have disappeared in the mammal? He also refers to the discovery that the development of the crop gland in the pigeon is stimulated by a (or, the) hormone of the pituitary which also stimulates the development of the mammary glands of the guinea pig. Here is an instance in which it is evident that the conception often implied in such terms as 'the œstrus-producing hormone' is not strictly correct, that the hormone does not cause the special development of tissue but that its presence is necessary to the development of which the potentiality is present in the genetic constitution. The testis hormone is necessary to the normal development of the antler in the stag but does not produce antlers in the stallion. Usually in experimental biology the pituitary of the ox is employed for researches on vertebrates of various classes, fishes, amphibia, birds and mammals, which implies the assumption that the internal secretions of the organ are essentially similar in all these classes. My theory that the mechanical stimulation, in one case of the membrane of the bird's crop, in the other of the dermal glands of the mammal, caused hypertrophy which in course of time affected the genes within the reproductive cells in association with the hormones of the pituitary, so that the hypertrophies became hereditary, is in harmony with the facts to be explained.

The case is quite similar to that of male sex-limited characters in mammals, where the testis hormone influences the development of antlers in stags, of teeth in the boar, and of the snout in certain seals. There are different responses to the same hormone, but the different responses correspond with different external stimulations. If it be replied that there is no evidence that the effect of such stimulations on the soma can produce any change in the genes, I can only point out that the association of the external stimulation with the presence of the hormones corresponds with the associations of the hormones with genetic development, and that it is impossible to ignore the fact that the hereditary hypertrophy controlled by hormones is physiologically of the same nature as the effects of the external stimulation, and the other fact that the stimulation is not merely hypothetical and supposed to have occurred at some remote period in the past but continues at the present day.

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Obituary

CANON JOHN ROSCOE

WHEN in the 'nineties of last century I had the great good fortune to make the acquaintance of my valued friend, the late Canon John Roscoe, he was settled as a missionary of the Church Missionary Society among the Baganda, the great tribe or nation which has given its name to Uganda, in Central Africa. But he had previously resided in the same capacity for some years in that part of East Africa now called Tanganyika, which was afterwards taken over by Germany and known as German East Africa. Of his life in that country and his observations of the native tribes he has given a brief account in a volume published long afterwards, "Twenty-five Years in East Africa". The account includes the notice of a curious form of human sacrifice practised by the natives which he succeeded in suppressing. He left the country at the time when the Germans took possession of it, and falling into the hands of the Arabs, who opposed the German invasion, he and his wife narrowly escaped being put to death by their captors, the messenger who brought their ransom only arriving about an hour before the time fixed for their execution.

It was not until he settled among the Baganda, however, that Roscoe began systematically to investigate and record the customs and beliefs of the natives among whom he lived. The results of his observations were first published in a series of valuable articles in the *Journal of the Anthropological Institute*, which are perhaps not wholly superseded by his systematic work on the subject, "The Baganda", which appeared some years later, in 1911. In his researches among the Baganda, he received important aid from his friend, the native prime minister of Uganda, who was not only himself versed in the lore of his people but also brought as informants from all parts of the country old men acquainted from their youth with the ancient traditions and customs which even then, at the beginning of the twentieth century, had passed or were passing out of use and even out of memory. Thus by his timely intervention, and the efficient help of his native informants, Roscoe was able to put on record a large body of information on the old life of the Baganda which otherwise would inevitably have been lost to science. His writings on the Baganda must therefore remain for all time the standard authority on that important tribe, one of the most powerful and most politically developed of all the Bantu peoples.

While his researches were in the main concen-

trated on the Baganda, Roscoe's anthropological enthusiasm, which never flagged, led him to extend his investigations to many other peoples of the Uganda Protectorate. He availed himself of his holidays to visit and examine some of them, particularly the Banyoro (or Bakitara), the Banyankole, and the Basoga, all of whose territories border on that of the Baganda, as well as other and more distant tribes, including the savage and cannibal Bagesu, on the slopes of the lofty Mount Elgon. The scientific results of these excursions he published in "The Northern Bantu", a volume replete with interesting information concerning these tribes, about which comparatively little had been previously known.

Even after Roscoe had returned to England in 1909 and was living in his quiet rural rectory at Ovington, near Thetford, in Norfolk, to which, in recognition of his eminent services to science, he had been presented by the University of Cambridge in 1912, his interest in these tribes of Central Africa remained unabated, and he longed to revisit them and push his investigations farther among them and among fresh tribes as yet untouched by European influence. Representations made on his behalf to the Government to enable him to undertake an expedition for this purpose were sympathetically received by Mr. Harcourt, then at the head of the Colonial Office, but they finally came to nothing. At last, after the War, his opportunity came, when the enlightened munificence of the late Sir Peter Mackie furnished him with the means of carrying out the wish of his heart. The funds provided by the generous donor were administered by a committee of the Royal Society, under the auspices of which Roscoe set out in 1919, and after spending about a year in the field returned in 1920. He husbanded his resources and secured complete freedom of movement by travelling alone except for the necessary bearers. It had been his wish and intention to examine the almost unknown tribes in the north-east, between Lake Rudolf and the southern border of Abyssinia, but unfortunately political complications in that region compelled him to abandon this important part of his programme, and that part of the ethnographical survey still remains undone, though I understand that there is some prospect of the blank being supplied before long by a younger investigator.

Thus restricted in the scope of his inquiries, Roscoe was obliged to retrace his steps over what to him was, in some measure, beaten ground. Still he made, in his year of absence, a wide circuit of the Protectorate, revisited his old friends the Banyankole, the Banyoro, the Bagesu, and the Basoga, and collected much additional information about them, besides breaking fresh ground among new and almost unknown tribes on the wilds of the lofty Mount Ruwenzori and elsewhere. The scientific results of his expedition were published by the Cambridge University Press in three volumes, "The Bakitara or Banyoro", "The Banyankole", and "The Bagesu". He also published a more popular account of the expedition under the title of "The Soul of Central Africa", in which descriptions of the native tribes are agreeably varied by graphic descriptions of scenery and incidents of travel—personal details which he always rigidly and rightly excluded from his strictly scientific writings.

On this expedition Roscoe devoted most time to the Banyoro or Bakitara as the most important and formerly most powerful tribe of the Protectorate after the Baganda. In his inquiries among them he received much help from the native king, who took great interest in the work and was at pains to supply Mr. Roscoe with the fullest and most authentic information. Thus my friend was enabled to do for the Banyoro what he had already done for the Baganda, to supply a great African tribe with an accurate account of its present state and past history, so far as these could be ascertained by personal observation and the most trustworthy native tradition.

As a field anthropologist, Roscoe had in his day few equals and probably no superior. He was a first-rate observer, with a keen sense of what is important and deserving of record; entirely free from theoretical bias, he always contented himself with stating in clear and simple language the results of his observations and inquiries; for him it was enough to record the facts; he did not attempt to explain them by his own or other people's theories. Still less did he fall into the trap, into which too many field anthropologists have tumbled, by comparing his African facts with facts raked together from all the ends of the earth: all such explanations and comparisons he rightly left to be elaborated by comparative anthropologists at home working in libraries on the reports of field ethnologists like himself. As one of these workers at home who have profited immensely by his researches in the field, the results of which he freely and generously communicated to me by letter and word of mouth as well as in his published writings, I desire to place on record my sense of the deep debt of gratitude under which he has laid all students of ethnology by his long and devoted labours in Central Africa. As documents of first-rate authority on the tribes of the Uganda Protectorate, his writings can never be superseded; they will remain imperishable monuments of the people and of the man.

But while his writings attest to the world the tenacity of purpose and the strength and keenness of the intellectual powers which enabled Roscoe to accomplish his great work under all the distractions of a laborious profession, and all the difficulties and hardships of long journeys performed in a tropical climate, for the most part in days when modern facilities of travel were still unknown, only his intimates knew the kindly sympathetic nature which endeared him to his friends and won the hearts of his dusky flock in Africa, as afterwards of his parishioners at home in England.

Of that, however, it is for others to speak. But

it would be wrong to conclude this brief and imperfect notice of Canon Roscoe's anthropological work without directing attention to one feature of it which added greatly to its value. All his information, I believe, was obtained directly from natives in their own language without the aid of interpreters, his own long and intimate familiarity with Bantu speech enabling him to dispense with those dangerous intermediaries in all his intercourse with the Bantu tribes who form the great bulk of the inhabitants of the Uganda Protectorate. Thus his reports of native customs and beliefs are entirely exempt from one most fruitful source of doubt, ambiguity and error which infests and tends to corrupt and falsify all testimony in passing through the medium of an interpreter, who, even if he be honest, may unconsciously pervert the purport of the communication he is charged to make through his imperfect acquaintance with one or both of the languages of which, as a go-between, he is obliged to make use. Readers of Canon Roscoe's works have, therefore, the satisfaction of knowing that the stream of his discourse flows pure and clear from native sources, unsullied by passing through the too often turbid and weedy channel of an intermediary. J. G. FRAZER.

BY the death of the Rev. John Roscoe, honorary canon of Norwich, at Ovington, Norfolk, on December 2, at seventy-one years of age, anthropological studies in Great Britain have lost a highly valued worker and the foremost authority on the beliefs and customs of former days among the Baganda and related peoples of East Africa.

John Roscoe, the son of James J. Roscoe of Liverpool, was trained as a civil engineer, but turned to mission work. After a period of training in the Church Missionary Society's college at Islington, he went out to Africa as a lay worker in the service of the Society in 1884. He was not ordained until 1893. In 1899 he became principal of the theological school at Mengo and, after holding this post for ten years, retired from mission work in 1909.

The early years of Roscoe's work as a missionary in Africa covered a stormy period in the history of Uganda, in which the intrigues of the king, Mwanga, and still more of his Lubare priests, played English and Protestants against French and Roman Catholics and Islam against both, until the establishment of a protectorate was forced on Great Britain as a virtual necessity. As the powerful king Mutesa had died only shortly before his arrival in the country, Roscoe had the advantage, inestimable for his subsequent studies, of seeing something of the working of a great African kingdom, even though in disturbed conditions, before it had been modified by European control. Further, in his studies of Baganda institutions his own first hand observation was supplemented by the help of his friend, Sir Apolo Kagwa, the native *katikiro*, or prime minister of Uganda, who not only gathered in his house for Roscoe's benefit old men from distant parts of the country, who were repositories of obsolete custom and belief, but also submitted Roscoe's material to the test of his own knowledge and critical judgment. Roscoe had taken up anthropological inquiry as a relaxation from teaching; but his early papers published in the *Journal of the Anthropological Institute* showed that he was a meticulously accurate observer, who at the same time was competent to see his facts in their broader relation. His reputation was confirmed and enhanced by his books, "The Baganda" and "The Northern Bantu".

On his return to England, Roscoe received an honorary M.A. degree from the University of Cambridge for his services to anthropological science, and lectured in the University on the anthropology of Africa. After a period of service as curate of Holy Trinity, he was presented by the University to the living of Ovington, which he held for the remainder of his life.

For eighteen years of his stay in Africa, Roscoe had been in close touch with Sir James Frazer. This association of field-worker and comparative anthropologist had proved little less fruitful on both sides than the similar association between Sir James and Baldwin Spencer in another field. In 1919 Roscoe was invited, through the efforts of Frazer, to undertake further work in East Africa as leader of the Mackie Ethnological Expedition under the ægis of a committee of the Royal Society. This was a one-man expedition, most of which was accomplished by bicycle. Roscoe visited a number of peoples on the Uganda-Congo border and on Mount Elgon, again keeping constantly in touch with Frazer by correspondence and report, as he maintained, to the great advantage of the work of the expedition. His results were embodied in three volumes, each with separate title, published in 1923, while a popular summary appeared as "The Soul of Central Africa". A general review of his life as missionary and anthropologist had already appeared in 1921 under the title "Twenty-five Years in East Africa". It is a book which by its restraint reveals the strength of his character.

WE regret to announce the following deaths:

Mr. Treacher Collins, formerly president of the Ophthalmological Society of the United Kingdom and of the International Congress of Ophthalmologists, known for his scientific investigations on the eye, on December 13, aged seventy years.

Prof. W. S. Thayer, emeritus professor of medicine in Johns Hopkins University, Baltimore, formerly president of the American Medical Association and president (in 1897 and 1913) of the International Medical Congress, known especially for his work on the pathology of the vascular system, on December 10, aged sixty-eight years.

News and Views

Warren Hastings and Science

MUCH has been written in the newspapers during the past week or so respecting the career of Warren Hastings in India, commemorative of the two-hundredth anniversary of his birth. Hastings was born on December 6, 1732, in Oxfordshire, and he died in 1818 at Daylesford, in Worcestershire. Little attention has been given, however, to Hastings' connexion with the world of science of his time. Six years after he had laid down office as Governor-General of India and had returned to England (1785), he was, on June 25, 1801, elected a fellow of the Royal Society. His certificate described him as a gentleman of great and extensive knowledge of various branches of science. He was living then in Berkeley Square, London. Among names appended in support were: James Rennell, Count Rumford, John Bruce, Caleb Whitefoord, and Mark Augustus Pictet. The first two were Copley medallists of the Society. Rumford's support of the ex-Governor-General of India is a particularly interesting feature of the candidature. In due course Warren Hastings attended and signed the charter book. It may be mentioned that in the last year of his administrative work in India, Hastings founded the Asiatic Society of Bengal, the first president of which was Sir William Jones. Though in itself nothing more than a coincidence, it is nevertheless of historic interest that the name of Capt. William Bligh, later (1805) Governor of New South Wales, who had accompanied Cook on his second voyage around the world, appears, along with Hastings, in the list of fellows elected into the Royal Society in 1801. His certificate was signed by Henry Cavendish and William Herschel, among others.

Centenary of Sir John Kirk

MONDAY next, December 19, marks the centenary of the birth of Sir John Kirk, naturalist, and exploring colleague of David Livingstone. Born at Barry, near Arbroath, Kirk was educated at the University of St. Andrews, graduating there in the medical faculty in 1854. He served on the civil medical staff during the Crimean War; afterwards, for six years as naturalist and second in command of Livingstone's exploring expedition in Africa. Entering the consular service, he became consul-general at Zanzibar (1873), and ultimately (1880), political agent. In the latter capacity his influence was of high importance in the administrative affairs of East Africa. Kirk accompanied the Sultan of Zanzibar on a visit to England in 1875, a treaty for the abolition of slavery in that potentate's dominions having been concluded. Sir David Prain has recorded that Kirk's memory is perpetuated in many ways: geographers allude to the Kirk Range, west of the Shire River; zoologists to Kirk's gazelle; and botanists to the genus *Kirkia*. Kirk was elected a fellow of the Royal Society in 1887, and the Royal Geographical Society awarded him its patron's medal in 1882. Kirk was created G.C.M.G. (1886) and K.C.B. (1890). He died on January 15, 1922.

The Dyestuffs (Import Regulations) Act

IN the House of Commons on December 8, an amendment for the omission of the Dyestuffs (Import Regulation) Act from the Expiring Laws (Continuance) Bill was defeated at the committee stage by 196 votes to 59. Replying for the Government during the debate, Dr. E. L. Burgin, Parliamentary Secretary to the Board of Trade, stated that the Government is still fully alive to the necessity of maintaining a flourishing dyestuffs industry in Great Britain, and referred to the definite cleavage of opinion between the users and makers of dyestuffs revealed in the third report of the Dyestuffs Industry Development Committee. This difference of opinion has been duly considered by the Government, and it is proposed to accept neither the majority nor the minority recommendations of the Report, but to extend the operation of the Act for a further year, during which period the Import Duties Advisory Committee will be asked to inquire into the whole circumstances of the dye industry and how the general interest may best be served. The whole matter will be referred to an impartial committee with all kinds of expert opinion available to it. When the Advisory Committee has reported it will then remain the duty of the Committee of Imperial Defence to intimate how the essential interests of national defence will be affected by any recommendations which may be made. The matter cannot be regarded as a purely industrial question. In the course of his speech, Dr. Burgin referred to the enormous advantage to Great Britain of the inclusion of the British dyestuffs industry within the international agreement between the German, French, Swiss and Italian makers. Careful inquiry has satisfied him, he said, that in regard to price the international agreement is not operating disadvantageously to Great Britain and the gold prices of the same colour do not vary to the disadvantage of the country.

Prevention of Distemper

THE inquiry into the causation and prevention of dog distemper started in 1922 has now been brought to a successful issue by the *Field* Distemper Council, Dr. P. P. Laidlaw and Mr. G. W. Dunkin, the Medical Research Council and the staff of the Wellcome Foundation at Beckenham. The disease has now been accurately defined and distinguished from other dog illnesses with which it used to be confused; it has been shown to be due to an ultramicroscopic virus and efficient methods of prevention have been worked out in the laboratory and confirmed in large-scale practical trials on packs of foxhounds and other dogs. Dogs are first given an injection of an emulsion of the organs of an animal which has died of acute distemper in which the virus has been killed with dilute formalin; in response, the animal develops a moderate degree of resistance which makes it possible, a fortnight later, to give it a dose of live virus which stimulates the animal to become definitely immune. The blood serum of such immune animals

can protect against the virus and is of use in treating cases of the disease and also in making a vaccinating mixture with live virus, which has the practical advantage of needing only one dose instead of two. These immunological reactions also make it possible to identify the disease with far greater certainty, and the new methods of prevention are available for ferrets, silver foxes, fitches, minks, etc., in which it has been found to occur.

Halley Stewart Laboratories of Physical Research

IT seems to be a remarkable coincidence that during the past century much of the research by the professors of physics in King's College, London, has been directly applicable to distant communication. Wheatstone appears to have been the pioneer and is known to all by his ingenuity and his discoveries which led to the invention of telegraphy. Maxwell, whose genius covered a wide range of study, is best known for work which is the theoretical basis of wireless transmission to-day. Richardson's work on the emission of electrons from hot bodies is applied in every wireless set. To-day, Appleton is in the forefront of the workers who are studying conditions in the upper atmosphere which control wireless transmission. But however comfortably his predecessors may have worked in the friendly atmosphere of the College, the conditions have so changed in the surroundings that Prof. Appleton finds himself obliged to work in a continuous electromagnetic storm—an atmosphere unsuitable to the character of the work in which he, his colleagues and his students are engaged. The work is already past the stage of a direct study of the conditions of wireless communication and has become of great importance in the study of the structure and nature of the upper atmosphere. By the refraction of wireless waves within the upper atmosphere, information is being obtained about the distribution of ionised regions. Thus hypotheses already applied in other branches of geophysical work come within the reach of direct experimental investigation.

THE problems which Prof. Appleton is attacking are of great complexity and it is clearly desirable not to add to the difficulty by working in a region so disturbed electrically as the Strand. Thus the generosity of the Halley Stewart Trust in providing new laboratories at Chesterford Gardens, Hampstead, is very opportune and is welcomed by the College and especially by the Physics Department. The work now in progress involves observations of a protracted nature—often over twenty-four hours—so that the convenience of a special laboratory with the director of research housed on the spot cannot be overestimated. The other branch of research to be undertaken in the building is concerned with the physical problems arising in the medical application of radium. This work is proceeding apace in London and one of its objects is to introduce scientific accuracy into the therapeutic use of radioactive substances. Already a number of students working under the direction of Dr. H. T. Flint are engaged in King's College and in Westminster Hospital Annexe on urgent problems in this branch of physics. The proximity of the new laboratories to Westminster Hospital Annexe will still further promote the close co-operation of the work in the two places.

Protein Swelling and Allied Phenomena

A CONFERENCE devoted to the subject of protein swelling, held under the auspices of the British Section of the International Society of Leather Trades Chemists, was held on December 1 at the Leathersellers' Hall, London, E.C.3. The introductory address was given by Prof. F. G. Donnan on the theory of membrane equilibria and the osmotic pressure of protein gels, in the course of which points connected with the Procter-Wilson theory of osmotic swelling were touched upon, and attention directed to the difficulty of applying this theory quantitatively to close-packed micellar systems such as hide. Mr G. S. Adair dealt with the osmotic pressure of the proteins, and described the assistance afforded by analysing such pressure into two partial pressures, one due to the protein ions and the other to the unequal distribution of ions. Dr. H. Phillips discussed the interaction of gelatin with acids and alkalis from the points of view of the electronic theory of valency and Bjerrum's *Zwitterion* constitution of amino acids. Mr. F. C. Thompson explained the two types of salt effect on the swelling of gelatin, one, an osmotic repressive effect on acid or alkali swollen gelatin, and the other a lyotrope effect on neutral non-ionised gelatin. Dr. R. H. Marriott, in his paper on swelling in alkaline solutions, put forward his views on the mechanism of the fixation of calcium by collagen, and the influence of the chemical constitution of keratin on its resistance to osmotic swelling.

THE more practical aspects of swelling and its bearing on leather manufacture were summarised by Dr. C. H. Spiers, who considers that plumping of hides is associated with a twisting and folding of the polypeptide chains in the crystallites of the fibrils. Dr. Dorothy Jordan Lloyd put forward explanations for the observed reductions in swelling power of proteins with increasing compactness of molecular organisation. The structure of wool keratin and its relation to swelling phenomena, was the subject of Dr. J. B. Speakman's paper, while the last paper was given by Mr. W. R. Atkin, on swelling in weak acids, in which it was pointed out that a careful consideration of Kuhn's work shows that the maximum swelling of gelatin in weak acid is at an external equilibrium of pH 2·4 in agreement with the earlier work of Procter.

Cinematograph Films of Cyclic Phenomena

MESSRS. DANCE-KAUFMANN, 18 Upper Stanhope Street, Liverpool, have produced some useful technical films which aim at the representation, by means of moving pictures, of phenomena which are cyclic, or may be considered so, for the purposes of exhibition. The operation of a diagram for the composition of rotating vectors; the summation of three alternating fields displaced in space and time;

or the action of the Oldham coupling are among the many subjects which are illustrated by the films. The diagrams appear as black lines on a lighted field, the dimensions of which are about 2 ft. by 1 ft. 6 in., with the 16 mm. film, and with a 50 watt projector; the visibility is sufficiently good with a shaded screen to provide for a class of thirty or forty students, and for a larger number in a darkened room. The fact that the films are in the form of endless bands and may be repeated indefinitely, and that the film may be arrested at any point for the purpose of measurement or explanation, should render them valuable for instruction in junior and for demonstration in senior classes. The range of films in the firm's catalogue is extensive and representative, including most branches of physics and engineering, and the presentment of the subjects is well considered. The cost of the films and projector is moderate and orders are accepted for special films to suit the requirements of individual lecturers. 35 mm., 16 mm. and 9·5 mm. films are available at the same price.

Gyroscopic Tops

AT the Friday evening discourse on December 9 at the Royal Institution, Prof. J. G. Gray discussed gyroscopic tops and combinations. After showing some preliminary experiments to illustrate the fundamental properties of the gyroscope, Prof. Gray proceeded to describe methods and technique he has devised for the production of self-erecting gyroscopes. Gyroscopes fitted axially with special point and ball pegs, mounted on cup supports, were shown to be self-erecting, the stability being the result of the special construction of the gyroscopes and their accessories. In some of the tops exhibited, devices called erectors are mounted on the casings of the gyroscopes; rotation of these erectors endows the tops with stability or instability according to the direction of rotation of the erectors. Generally speaking, an erector consists of a normally horizontal plate on which rest spherical masses, or to which masses are pivoted, the construction being such that when the top is vertical the masses, as a consequence of the rotation of the plate, dispose themselves symmetrically with respect to the axis of the top; but when the top is inclined to the vertical, and the plate to the horizontal, the masses move about relatively to the plate in such manner that, providing the plate is rotating in the direction of spin of the gyroscope, the top experiences an erecting couple, and thus becomes endowed with a sense of the vertical. Gyroscopic tops were shown which are self-erecting as a result of the special construction of the pegs on which their casings revolve. Further tops exhibited are rendered stable, or unstable, at will by rotation of the cups on which the pegs are supported. Members of this latter family of tops were caused to erect themselves from initial positions in which their axes of spin were horizontal to those in which their axes were vertical, and then to return to positions in which their axes were horizontal.

Development of the Electrical Industry

IN the third of the series of lectures on industrial affairs at the Imperial College of Science, Mr. Maurice Solomon discussed certain aspects of the electrical industry. He emphasised that further development of the industry would involve a more widespread use of electrical appliances in the household. Such appliances must be properly standardised so as to be readily interchangeable. Moreover, there must be standardisation of quality, for it is of the utmost importance that the user shall acquire and retain confidence in the safety and smooth working of electrical apparatus. As an indication of the extent to which electricity may be applied in the modern household, Mr. Solomon said that in his own house there are some twenty-eight different types of electrical appliance in use. The electrical industry is still young and there is no lack of appreciation of the importance of research in its future development.

Organisation and Co-operation in Industry

MR. SOLOMON then discussed the general proposition that the organisation of an industry into large firms or groups of firms is advantageous to that industry and to the general community. In Great Britain we have looked askance at the cartel as tending to the raising of prices and the stultification of progress through the elimination of competition. Actually, the cartel does not eliminate competition but merely reduces it to a reasonable level, and there is now a growing appreciation of the evils of unrestricted competition. In any event, competition is by no means the only incentive to progress: markets may be extended by fostering a wider public demand as well as by capturing the existing trade of competitors. Moreover, criticism by the public is an ever present incentive to progress, even in the case of a monopoly. On the other hand, the small concern which puts on the market a standard article at cut prices is taking advantage of the results of research which it could never have carried out for itself, and is thus shirking responsibility for the progress of the industry and for service to the community. A large firm or group of firms by efficient organisation can maintain a large output of products of a high and standard quality under conditions which enable those engaged in the industry to earn a reasonable living; and by control of production and prices, can minimise the evils arising from alternations of slump and boom. The co-operative research which an association of firms can undertake affords the key to future progress not only in the industry immediately concerned but also in cognate industries.

Television in the United States

IN the *Journal of the Television Society* for September, there is an interesting paper by Mr. A. Dinsdale on "Television in America To-day". He points out that those concerned with television development are either research workers or companies interested in existing equipment. For the last two years, the Bell Telephone Laboratories have been experimenting with a two-way television

system over telephone lines between two buildings in New York which are two miles apart. Even when perfected, it is not certain whether there would be a commercial demand by the public for a costly facility which would enable them to see the person telephoning. At the General Electric Company's laboratories at Schenectady, experiments are being made on the transmission of television signals along a light beam instead of by wire or radio. Nothing very novel has recently been published in connexion with cathode ray television. The National Broadcasting Company is building a new television studio on the eighty-fifth floor of the Empire State Building at a height of 1,000 feet above the street. The short-wave transmitting aerial is on the top of the airship mooring mast and is 1,250 feet above the street. The received images will be six inches square and will be seen directly on the end of a cathode ray tube. Transmissions will be made from the Empire State studio on wave-lengths of 5–7·5 metres.

Supply Undertakings and the Grid

IN an article in the *Times Trade and Engineering Supplement* for November 19, Mr. Charles D. Taite, of the Lancashire Electric Power Company, discusses the grid from the point of view of the supply undertakings affected by it. We are glad to learn that the supply undertakings, several of which strongly opposed the Act of 1926, are now willing to co-operate with the Central Electricity Board in making the schemes which have been carried out under the provisions of the Act a success. This is wise, seeing that they pay the whole of the charges in connexion with the grid and are therefore vitally interested in its success. Since the Act came into operation, a wave of industrial depression has swept over the world and although the use of electricity in Great Britain has continued to expand, the growth is less than it would have been under normal conditions. In some areas, factories have closed down. In textile areas, many mills have gone permanently out of commission. On the Clyde and the Tyne, shipbuilding has fallen on evil days. On the other hand, new openings have been found for electrical development; rural electrification has commenced and electricity is being more widely used by the householder. But beneficial as these developments are, their effect is comparatively insignificant compared with the enormous growth which would take place with a return to good trading conditions. Some indication of what might be expected was experienced in the textile areas of Lancashire last autumn, following the revival which took place in the demand for textile goods. The load on many undertakings expanded by 15 per cent, and had the revival been maintained throughout the year, another 15 per cent improvement would have been reached. The heavier the load the less will the supply companies' fixed charges per unit to the Central Electricity Board be and the cost of electricity would be cheaper. In Mr. Taite's opinion, there is still an almost unlimited field for electrical enterprise.

Outdoor Museums in the United States

PUBLIC museums in the United States of America have been increasing in numbers in recent years at the rate of one every fortnight, and their standard of efficiency as educational agencies has been rising. The American Association of Museums has been taking stock of the museum resources of the country, and has made available a considerable mass of new statistical information on which the Association's director, L. V. Coleman, has based an interesting report on "Recent Progress and Condition of Museums". This has been published by the United States Office of Education as Bulletin No. 30, 1931. Among recent developments is the appearance of museums of science in national parks. The underlying idea of these is that museums attempt, too often without success, to tell indoors, with the aid of objects that are fragments or imitations, stories that should be told where Nature has provided genuine illustrative exhibits. 'Trailside' museums, each given over to a restricted subject, are found to be more useful for some kinds of instruction than cases in a museum building. The first demonstration was made a few years ago in the Yosemite, and the most recent is an extensive series of 'trailsides' in the Yellowstone National Park. Simultaneously with this exploitation of the resources of the national parks, museums in cities have been moved to search local parks for natural features that can be explained on the spot. The influence of the movement has spread into the field of history also, as in the George Washington birthplace national monument, and a newly appointed park historian is developing history education, just as the park naturalist has developed natural history education. The number of museums doing good educational work a decade ago was not more than a dozen; now it is in the hundreds.

The Auckland Museum and Institute, New Zealand

THE Auckland Institute and Museum, now in its second year of occupation of the fine Memorial Building, has of necessity been undergoing a revision of its extensive collections. But in addition it has been able to carry out a very successful expedition for the investigation of the natural history and ethnology of the northernmost portion of the North Auckland peninsula (Annual Report for 1931–32). Another notable activity of the staff is the furthering of the educational side of the Museum by lectures within the building and in the district, the Sunday afternoon public lectures having proved specially attractive; as well as by the formation of clubs for boys and girls, the preparation of exhibits for schools, and the arrangement of special exhibitions. An exhibition of antique plate, chiefly of the seventeenth and eighteenth centuries, increased the attendance by a thousand a week during its course; the weekly average number of visitors throughout the year was 2,856. The membership, like that of most similar bodies, shows a slight falling off in numbers, but the present roll still includes 588 names, 157 representing life members with a capital subscription fund exceeding £2,000.

The Problem of Wilkes Land

IN the United States Exploring Expedition of 1838 Charles Wilkes reported various landfalls near the antarctic circle south of the Indian Ocean. A number of soundings also showed a continental shelf. On this evidence, Wilkes suggested the existence of an antarctic continent and the lands were long referred to collectively as Wilkes Land. D'Urville at the same time found Adélie Land, which appeared to be part of the same coast-line. Subsequent explorations in these waters, principally by Capt. R. F. Scott and Sir Douglas Mawson, failed to establish all Wilkes's landfalls in the position originally assigned. This had led to the suggestion that he was mistaken and the tendency is to restrict the use of the name, Wilkes Land. Prof. W. H. Hobbs in an article in the *Geographical Review* for October 1932 discusses this problem and publishes a map on which subsequent discoveries have been printed over those of Wilkes. If Wilkes's latitudes were wrong in many cases, his longitudes show considerable correspondence to actual land. Pack-ice prevented his close approach and the distance of his 'lands' had to be estimated. Allowing for the liability to underestimate distances in the remarkably good visibility, and the lack of cross-bearings to fix position, Prof. Hobbs argues that recent work has re-established Wilkes Land in the wider sense and exonerated Wilkes from the charges that have been brought against him. The name is a useful one to embrace many small lands and might well be retained.

Radium from Canadian Pitchblende

THE Industrial Information Bureau of Canada announces that a new commercial process of radium extraction has been successfully accomplished by R. J. Traill and W. R. McClelland of the Department of Mines at Ottawa. On account of the high-grade character of the pitchblende ores from the Great Bear Lake area, and partly because of the simplified technique that has been developed, it is believed that the costs of radium production will be considerably less than has hitherto been practicable. Instead of some forty operations involved in the Belgian method, radium salts can now be produced in the Government Laboratory with less than half that number of steps and in six weeks instead of three months. The chief cost in radium separation arises from the necessity of using about three tons of chemicals for the treatment of every ton of ore. The new process has been adapted to treat with almost equal success both siliceous ore and the silver carbonate ore with which pitchblende is found associated in the Great Bear Lake field. Ten tons of ore are estimated to produce about 1 gm. of radium. Already some 4,000 gm. of radium concentrates have been extracted in the preliminary experimental work. Canada's first radium refinery is now being established at Port Hope, Ontario, to which point the ore will be brought for the extraction of radium and various by-products such as uranium, lead and silver.

The Personality of Britain

THE valuable synthetic study of prehistoric Britain as an environment of man which Dr. Cyril Fox delivered as a lecture to the First International Congress of Prehistoric and Protohistoric Sciences (see NATURE, Aug 13, p. 247), has now been published by the National Museum of Wales under the title "The Personality of Britain: its influence on Inhabitant and Invader in Prehistoric and early Historic Times" (Cardiff: National Museum and Press Board of the University of Wales, pp. 84, price 2*s*. 6*d*.) In a preface, Dr. Fox points out that publication has been undertaken appropriately by the National Museum since not only does Wales form an integral and important part of the highland zone which he differentiates in the course of his argument, but also characteristic examples of the objects of material culture with which he deals may be seen in the galleries of the Museum. The value of the text as published is much enhanced by a full series of distribution maps, most of them based on material which Dr. Fox himself has collected in the course of the past five years and in the preparation of which he has had the assistance of Miss L. F. Chitty. Archæologists will be grateful to the National Museum of Wales for having so speedily made accessible this valuable and comprehensive study of the influences of geographical environment in Great Britain between *circa* 2500 B.C. and A.D. 1000.

Tea Cultivation

TEA is an unusual crop from the point of view of the cultivator because it is necessary to keep the bush in vigorous vegetative growth and at the same time continue to remove the young vegetative shoots, which are plucked by breaking them off with the thumb and forefinger, the bud and the next two open leaves being thus removed. Naturally, therefore, pruning methods, manurial treatments, etc., will be controlled by different considerations than where an orchard tree is cultivated for its flower and fruit production. Interest is now being taken in the cultivation of tea in Malaya, where the central highland regions are being opened up. Mr. E. A. Curtler was therefore sent on tour to Ceylon and India to obtain the most recent information on methods of tea cultivation and manufacture, and his impressions and experiences are embodied in an interesting publication of the Department of Agriculture of the Federated Malay States (General Series No. 9, 1932).

The Psychology of the Family

DR. PRYNS HOPKINS, in the *Sociological Review*, vol. 24, No. 2, considers the psychology of the family. He reviews the nature of the chief instincts concerned and he stresses their liability to fixation at, or regression to, any of the numerous stages in their development. Consequently, he suggests that in the pre-marital state, moderate promiscuity should be sanctioned as most likely to promote healthy and complete development, and wise choice of the permanent partner. In the

marital state, he insists that the sole bond must be that deep affection which may be a concomitant of desire, and is the cause and justification of monogamy. Finally, he pleads for frankness towards children in matters of sex, and asserts that those who do receive this from parents obviously fond of them, and not strained in their personal relationship, are most likely to grow up healthily and happily. The greater freedom for experiment which he demands that society introduce into the convention of the family is well supported by his argument. The paper is naturally controversial, but it would benefit by the suppression of the sentimental note which is occasionally apparent.

King's College (London) Engineering Society

THE "King's Engineer", the annual of the Engineering Society and the Engineering Branch of the Old Students' Association of King's College, London, which has recently been published, is one of the most interesting publications of its kind and affords evidence of the engineering activity of the College. Fourteen papers were read by the members of the Engineering Society during the year, and four of these are reprinted in the annual. The paper on the "Development of High-Speed Compression Ignition Engines", by V. H. F. Hopkins, was the prize essay. Another paper of considerable interest is that by A. H. Jenkins on "China-Clay and China-Clay Mining in the West of England". The number is issued as a memorial volume to Prof. Ernest Wilson, who for more than thirty years was professor of electrical engineering, and who endeared himself to all King's College students. Prof. G. Cook gives an appreciation of Prof. Wilson's work, and a list of his papers.

Survey of India

THE Survey of India has published its report on map publication and office work for the year ending March 31, 1931 (Calcutta, 1932. 1 rupee). The most important part of the publication is the series of index maps of all the maps of India, including the 'Million Map' sheets. Practically the whole of India, but not Burma, and also Afghanistan, Baluchistan and Persia now appear on the useful southern Asia series of one in two million, while the greater part of India is also published on the one to a million scale of the Carte Internationale du Monde. The larger scale maps make good progress and some two hundred new sheets on different scales have been published during the year.

Electric Supra-Conduction in Metals

PROF. J. C. MCLENNAN writes as follows: "It is regrettable that in my article on 'Supra-Conduction in Metals' published as a supplement to NATURE of December 10, there were two undetected typist's errors that should have been corrected. In the third section of the article the words 'copper sulphate' should read 'copper sulphide' and in the last section the words 'wire lattice' should read 'ionic lattice'. It may be of interest to state here, too, that Prof. R. de L. Kronig's paper on the electron lattice theory of supra-conduction in metals appeared in the *Zeitschrift für Physik*, Bd. 78, Heft. 11 and 12."

Announcements

THE annual meeting of the British Association will be held next year in Leicester on September 6–13 under the presidency of Sir F. Gowland Hopkins, president of the Royal Society. The following sectional presidents have been appointed: Section A (Mathematical and Physical Sciences), Sir Gilbert Walker; B (Chemistry), Prof. R. Robinson; C (Geology), Prof. W. G. Fearnsides; D (Zoology), Dr. J. Gray; E (Geography), the Right Hon. Lord Meston; F (Economic Science and Statistics), Prof. J. H. Jones; G (Engineering), Mr. R. W. Allen; H (Anthropology), the Right Hon. Lord Raglan; I (Physiology), Prof. E. D. Adrian; J (Psychology), Prof. F. Aveling; K (Botany), Prof. F. E. Lloyd; L (Educational Science), Mr. J. L. Holland; M (Agriculture), Dr. A Lauder.

MR. J. BERNARD CALKIN, Wychwood School, Bournemouth, states that in his letter entitled "Implements from the Raised Beach at Slindon Park, Sussex" (NATURE, Nov. 26, p. 813) the reference "to the Cannon shot gravels as being of interglacial age was an oversight. As they are actually a glacial deposit, I conclude that most of the Slindon beach belongs to the preceding interglacial period."

IN commemoration of the seventieth birthday of Sir P. C. Rây, founder, foundation-president and patron of the Indian Chemical Society, a jubilee volume, of some 350 pages, is being published by the Society, containing contributions from many eminent chemists in India and abroad. Orders for the volume should be sent to the Honorary Secretary, Indian Chemical Society, P.O. Box 10857, Calcutta.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A head of the Chemistry Department of the Municipal Technical College of Kingston-upon-Hull—The Director of Education, Education Offices, Guildhall, Hull (Dec. 31). A librarian and keeper of records in the Department of Antiquities, Palestine—The Director of Recruitment (Colonial Service), 2, Richmond Terrace, Whitehall, London, S.W.1 (Dec. 31). An examiner in domestic science and assistant examiners in mathematics, chemistry and other subjects for the School Certificate Examination for 1933 of the Central Welsh Board—The Clerk to the Central Welsh Board, Cardiff (Jan. 14). A head of the Civil and Mechanical Engineering Department at the Northampton Polytechnic Institute, St. John Street, London, E.C.1—The Principal (Jan. 20). A professor of experimental physics at the Queen's University of Belfast—The Secretary (March 18). A professor of zoology at the University of Leeds—The Registrar. A secretary to the Society for Cultural Relations between Great Britain and the U.S.S.R.—The Chairman, S.C.R., 1, Montague Street, London, W.C.1.

Letters to the Editor

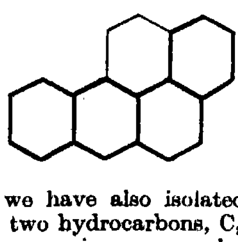
[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Coal Tar Constituents and Cancer

THE nature of the cancer-producing constituent (or constituents) of coal tar has been under investigation in this and other laboratories for some years past, but hitherto no known constituent of tar has been found to have definite cancer-producing properties, and no new carcinogenic constituent has been isolated. The isolation has now been accomplished by concentrating active fractions of coal-tar pitch, making use of the method of fluorescence spectroscopy introduced here by W. V. Mayneord. This brought to light a spectrum which was found to be common to many carcinogenic mixtures.[1] The methods adopted have included fractional distillation, solvent extraction, and crystallisation of picrates and of the products of their decomposition with alkali.

In this way a very active carcinogenic hydrocarbon has been obtained, which in the pure state has the typical fluorescence spectrum to which reference has been made above. For reasons which cannot be detailed here, we formed the opinion that this hydrocarbon was possibly 1 : 2-benzpyrene. This compound was unknown, but has now been synthesised here from pyrene by way of β-1-pyrenoylpropionic acid, γ-1-pyrenylbutyric acid, and 4′-keto-1′: 2′: 3′: 4′-tetrahydro-1 : 2-benzpyrene. The synthetic sample of 1 : 2-benzpyrene produced cancers of the skin in mice just as rapidly as the material isolated from pitch.

The tumours appeared, so far as can be judged from the limited number of experiments on mice yet carried out, in approximately half the time required for tumour production by 1 : 2 : 5 : 6-dibenzanthracene, so that 1 : 2-benzpyrene is much the most active carcinogenic hydrocarbon yet known. We do not claim that this is the only carcinogenic compound present in coal tar. The relationship of this new hydrocarbon to 1 : 2-benzanthracene, the parent substance of the group of cancer-producing hydrocarbons already described,[2] is shown by its structural formula, the benzanthracene ring-system being indicated by heavy lines:



In addition, we have also isolated from coal-tar pitch the other two hydrocarbons, $C_{20}H_{12}$, composed entirely of benzene rings; namely, perylene and 4 : 5-benzpyrene. The identification of the latter hydrocarbon was effected by synthesis. Moreover, we have isolated 1 : 2-benzanthracene from the chrysene fraction of coal-tar. None of these four hydrocarbons had previously been recognised as a coal-tar constituent. A more complete account of these experiments is being prepared for publication.

We gratefully acknowledge our indebtedness to Prof. E. L. Kennaway for his helpful encouragement during a somewhat long and arduous task.

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Dec. 2.

[1] Hieger, *Biochem. J.*, **24**, 505; 1930.
[2] Cook, Hieger, Kennaway and Mayneord, *Proc. Roy. Soc.*, *B*, **111**, 455; 1932.

Tribulosis and Methæmoglobinæmia in South African Sheep

IN the investigation of the disease 'tribulosis' or 'geeldikkop' (literally, 'yellow-thick-head'), which causes heavy mortality among sheep in the Karroo area of South Africa, it was observed by one of us[1] that death from methæmoglobinæmia followed administration of the press juice of the plants held responsible for the causation of the disease. Animals grazing upon different *Tribulus* species (Zygophyllaceæ) at certain periods of the year (summer months) evince a marked photosensitivity accompanied by more or less intense icterus. The swellings of the lips, ears and head, those parts least protected from the sun's rays, are followed by necrosis and mummification of these parts, which may be so intense that the animal is quite unable to eat or drink. Death follows from inanition, toxæmia and jaundice.

Methæmoglobinæmia has never been recorded as a clinical symptom. With the exception of the jaundice, the clinical picture very closely simulates that produced by experimental *Hypericum* or hæmatoporphyrin sensitisation.[2]

The rôle of the plants mentioned in causing the disease has been established by feeding tests carried out at the scene of an outbreak, but so far no clue as to the nature of the toxic substance responsible has been obtained, neither has the disease been produced experimentally outside the areas in which it normally occurs. Outbreaks are very spasmodic, even capricious, in appearance. It is felt by us that a certain set of physiological conditions is necessary, both of the plant and of the animal, for the characteristic syndrome to develop.

In testing the toxicity of *Tribulus* plants at Onderstepoort, death invariably resulted from methæmoglobinæmia within 3–4 hours of dosing (by stomach tube) with the freshly expressed juice of the green plant, or water extracts of the dried, powdered material. Although the symptoms of such poisoning differed markedly from those of the disease as it is seen in the field, it was decided to attempt the isolation of the responsible substance.

We have succeeded in proving that the formation of methæmoglobinæmia is due to nitrite, not present as such in the plant, but formed from nitrate by an extremely active reducing system.

Determinations of nitrate content by the method of Strowd[3] (except that extracts were made with boiling water), showed that our dried, powdered samples of *Tribulus* plants from various localities contained between 3·2 and 2·2 per cent, reckoned as KNO_3, on the dry weight basis. Since conversion of nitrate to nitrite and reaction of this with amino bodies, etc., takes place during the drying process, the actual amount of nitrate in the fresh plant is

probably considerably greater even than these figures indicate.

Crystalline potassium nitrate was isolated from the material in fair yield. The enzyme system appears to be insoluble or bound to the denatured proteins and it was found possible to wash the plant powder free from nitrate and then to effect enzymic reduction of added nitrates. Reduction may proceed slowly, beyond the nitrite stage, and the various intermediates, such as hydroxylamine, have been under consideration as possible toxic factors.

By analogy with the work of Warburg and Negelein[4] upon the alga *Chlorella pyrenoidea*, it may be assumed that reductive processes are so controlled in the living tissues of the higher plant that nitrites are not produced in any appreciable concentration from the reduction of nitrates. Nitrite may be looked upon as a product of a deranged metabolic activity. This explains why methæmoglobinæmia is not observed clinically in sheep grazing upon living *Tribulus* plants.

Incidentally, we have also demonstrated that if fairly large doses of nitrates are given by stomach tube to normal sheep, the reducing activities of the bacteria, yeasts, etc., in the rumen may be great enough to produce sufficient quantities of nitrite to cause death from typical methæmoglobinæmia: for example, with daily doses of 10–20 gm. in two to three days.

What relation, if any, this toxic factor present in *Tribulus* plants bears to the causation of the disease 'tribulosis' we are not at present prepared to say. The fact that, in both, pronounced hæmoglobin changes, in one case leading to methæmoglobin formation, in the other to excessive bile pigments, are the predominant pathological findings, may be of some significance. On the other hand, we have failed to reproduce either the photosensitivity or the icterus of 'tribulosis' by prolonged administration of dried *Tribulus* plants, potassium nitrate, potassium nitrite, hydroxylamine hydrochloride, hydrazine sulphate and ammonium carbonate either alone or in combination.

'Geeldikkop' is apparently not caused only by species of the genus *Tribulus*, since an identical condition, usually of less severity, has been observed in areas where no *Tribulus* grows, and in these cases, lucerne, *Panicum* spp, *Setaria* spp. and possibly other widely differing plants have been incriminated.

For these reasons we believe that the true causative factor of 'tribulosis' is not a specific substance, peculiar to the genus *Tribulus*, but, as stated, we are inclined rather to the view that some simple substance arising either in the animal or the plant as a result of disordered metabolism, possibly through wilting, and acting in conjunction with a peculiar set of conditions, are to be held responsible for the disease.

Normally the plant is an excellent fodder plant. We would welcome any suggestions or comments that would help to throw light upon this obscure and involved problem.

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Oct. 19.

[1] Quin, J. I., 16th Rept. Dir. of Vet. Services and Animal Industry. Union of South Africa. Aug., 1930.
[2] Quin, J. I., 17th Rept. Dir. of Vet. Services and Animal Industry. Union of South Africa. Aug., 1931.
[3] Strowd, H. W., *Soil Science*, 10, 333–342; 1920.
[4] Warburg, O., and Negelein, E., *Biochem. Z.*, 110, 66–115; 1920.

Photochemical Reaction of Hydrogen and Chlorine

THE recent appearance of a note by W. H. Rodebush and W. C. Klingelhofer[1], in the course of which they mention that they find water vapour to have no effect on the length of the chain reaction induced in a mixture of hydrogen and chlorine by chlorine atoms, suggests to us that a mention of experiments of our own of a similar nature would be of interest to others. Like the above authors, we were aware of the results of Prof. Bodenstein, who courteously informed us last May that, in the course of comprehensive experiments, he had been unable to inhibit the photochemical reaction of hydrogen and chlorine by intensive drying.

The first indications of this sort in our case were noticed in the summer of 1930,[2] when the reaction in question was found to proceed without hitch at chlorine pressures so low as 0·012 mm., a figure controlled by immersing a side tube of the apparatus, containing solid chlorine, in a bath of melting allyl chloride (136·6° K.). The vapour pressure of ice at this temperature is of the order of 10^{-8} mm., apart from the possible formation of chlorine hydrate. The soda-glass apparatus was well evacuated and baked out before use. Subsequent work during the last two years under similar, though modified, conditions has always given the same type of result. As, however, there was the possibility of slow distillation of water vapour through the reaction zone from some part of the apparatus which had been insufficiently baked out, and, in particular, as in many of our recent experiments we had employed taps lubricated with phosphoric acid (private communication from Mr. D. L. Chapman) it was decided to submit the point to a more rigorous test.

The soda-glass apparatus was provided with a sealed-in palladium tube at the end remote from the pumps, and the whole, including the Pirani gauge (Rollefson's pattern) was thoroughly baked out in a rapid stream of hydrogen admitted through the palladium. The prevailing pressure of this gas during the process was of the order of 1 mm. After cooling in the gas stream and evacuating, chlorine was distilled into a side tube immersed in liquid air, the greater part of it distilled out again, and liquid air replaced on the side limb. The baking out in the hydrogen stream of the whole apparatus, with the exception of the chlorine supply tube, was repeated for eight hours at a temperature of 200° C., and the apparatus was sealed off from the pump whilst the hydrogen stream was still running. After cooling, the liquid air on the chlorine supply was replaced by a bath of melting methyl-cyclohexane (p_{Cl}, 0·11 mm.), and the apparatus, which contained about 0·5 mm. of hydrogen, insolated by light from a metal filament lamp filtered through a 5 mm. glass plate. Several successive runs gave perfectly normal reaction rates. Blank experiments showed that any formation of hydrogen chloride at the palladium tube surface was negligible.

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Nov. 25.

[1] *Proc. Nat. Acad. Sci.*, 18, 531; 1932.
[2] Bateman and Craggs, *Trans. Faraday Soc.*, 27, 445; 1931.

Dependence of Electrical Conductance and Dielectric Constant upon Frequency in Mixtures of Strong Electrolytes

THE properties of the ionic atmosphere in the new electrostatic theory of strong electrolytes are very important in regard to reversible thermodynamic and irreversible processes.[1] They enable us, for example, to develop a theory of the irreversible conductivity processes and of the irreversible mechanism that is involved in the viscosity phenomena in the case of a simple electrolyte. We have recently been able to find the general relation between frequency and electrical conductance and dielectric constant in mixtures.[2] From our general equation of the force of relaxation one can now derive a detailed discussion of the quantitative limiting laws of the conductivity and the dielectric constant in mixtures of strong electrolytes. The special discussion—for example, of the problem of 3-ions and 4-ions and so on—is very complicated and will occupy some time.[3]

We thought it desirable, however, to give at once a theoretical explanation of the new experimental work done by Spaght.[4] Spaght has inquired into the dispersion of the conductance of two mixtures of strong electrolytes. His results can be explained theoretically—in a qualitative manner at least—by a further generalisation of the calculations made by Bennewitz and Wagner-Küchler, who have worked out only the stationary case, where a relatively small quantity of ions of sort (3) are mixed with an electrolyte consisting of ions of sorts (1) and (2). Our calculations deal with the non-stationary case and give the expression for the mobilities and the dielectric constant of an electric field alternating with high frequency. Even in this simple case, the expressions for the electrical conductance and the dielectric constant are relatively complicated. We will not give this expression now, as it will be published shortly.[5]

It would be very interesting to compare the theoretical results with further systematic experimental studies which will have to be carried out in the future. In the case of a simple electrolyte, this has been done successfully by many workers who obtain quantitative agreement with the theory of Debye-Falkenhagen. (See the monograph by Falkenhagen, loc. cit.) It should be possible to investigate not only the dependence on frequency of the electrical conductivity but also that of the dielectric constant effect by means of the method worked out by M. Wien.[6] The latter effect is based on the fact that we have a phase difference between the field strength and the ionic velocity produced. That means an electric field produces two components of the electrical current; one of them has the same phase as the field strength and the other one is in phase with the differential quotient of the field with respect to the time or the Maxwell displacement current. The quantity of the displacement current is proportional to the dielectric constant. Hence we get an alteration of the dielectric constant (relatively to the dielectric constant of the pure solvent) which is dependent on the frequency of the field.

It is easy to see that we have to deal with an increase of the dielectric constant. Consider a quick displacement of a central ion; the consequence of the finite time of relaxation of the ionic atmosphere is that a quasi-elastic force will arise which will repel this central ion to its original position. This quasi-elastic binding between the ions means an increase of the dielectric constant. In the case of more concentrated solutions and relatively very high frequencies, there will be, of course, other interesting effects on the conductance and the dielectric constant, for example, the quantum mechanical forces, dipole effect, effect of solvation and so on.

One important point of view in the development of the theory of electrolytic solutions has yet to be considered. The Debye theory is applicable only in the case of sufficiently dilute solutions and gives the quantitative limiting laws. The electrostatic theory makes use only of the Coulomb forces between the ions. Not only are the electrostatic forces, which means the Coulomb forces and the forces of polarisation, significant, but also the quantum mechanical forces and the interionic dispersion forces are of great importance. The latter correspond to the van der Waals' forces in the case of gases and are not only of electrostatic nature but also of quantum mechanical nature in the sense of London, Eisenschitz and Margenau.

Taking into account these ideas one has to replace the interionic forces *in vacuo* by the corresponding forces in a solvent; that means that in the first approximation one has to substitute e^2/Dr for e^2/r in the formulæ developed by the quantum mechanics, where D is the dielectric constant and e the electric charge.

It would be very interesting to extend the theory in this direction. We believe that it would be possible to develop a statistical treatment of more concentrated solutions in the sense mentioned above. This is one of the most interesting problems in the field of electrolytic solutions.

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[1] A complete treatment of the modern theory of electrolytes and critical handling of the experimental data has been tried in the monograph "Elektrolyte" by H. Falkenhagen, Leipzig, S. Hirzel, 1932. The English translation will be published in the series of monographs edited by Prof. R. H. Fowler (Cambridge University Press).

[2] H. Falkenhagen and W. Fischer, *Phys. Z.*, in press.

[3] One of us (Fischer) will give the special discussion in a forthcoming dissertation.

[4] Spaght, *Phys. Z.*, **33**, 534; 1932.

[5] A paper to be published in the *Physikalisches Zeitschrift* (1933).

[6] M. Wien, *Phys. Z.*, **31**, 793; 1930. **32**, 183; 1931. *Ann. Phys.*, (5) **11**, 429; 1931.

Infra-Red Absorption of Quartz

IN 1895 Merritt,[1] observing the infra-red absorption in the $2 \cdot 9\,\mu$ region of a beam passing at right angles to the axis in crystalline quartz, found a definite difference when the radiation was polarised in planes at right angles and parallel to the axis. That is, the ordinary and extraordinary rays respectively were differently absorbed. The absorption of a beam parallel to the axis was, as was to be expected, similar to that of the ordinary ray in the first case. Koenigsberger[2] in 1897 made like observations.

I am unaware of any subsequent investigation of this effect in this region and wish to direct attention to its importance, especially as the absorption bands for radiation passing parallel to the axis may be required to serve as standards of wave-length in the infra-red. Dreisch[3] has published a curve showing four bands in this region though he only states the wave-lengths of three of them.

I have recently examined specimens of quartz with

unpolarised radiation passing parallel and at right angles to the axis and have been fortunate in having available, by the courtesy of Messrs. A. Hilger Ltd., unusually large thicknesses of the material. The differences in both intensity and structure of the bands for the two directions are striking as may be seen from Fig. 1. The figure also shows the curve of galvanometer deflections (III) using a small 'hohlraum' as source. The bands recorded by Dreisch for crystalline quartz parallel to the axis appear in this curve and are due to the prism, which was of quartz. There is an apparent wave-length discrepancy between curves I and III, because I is referred to a horizontal datum and III to an energy curve falling fairly steeply to the right. This causes an apparent displacement of the bands in III to the right.

It appears, from curve I, that the ordinary ray is completely absorbed between $2 \cdot 83\,\mu$ and $3 \cdot 02\,\mu$ in 63 mm. of quartz. In the 83 mm. used for curve II there is nevertheless a measurable fraction of radiation transmitted, which must be ascribed to the extraordinary ray. Allowing for a 50 per cent initial loss from the beam by absorption of the ordinary ray, it follows that the general intensity of absorption of the extraordinary ray must be considerably less than that of the ordinary ray in this region. Further, a comparison of curves II and III suggests that the band structures will prove different. The wave-length of maximum absorption of a band will therefore vary with the direction and state of polarisation of the beam in the quartz. The differences extend some distance on each side of the region mentioned, although here they are not so directly interpreted, and it is interesting to note that Barnes[4] has recently obtained indications of similar dichroism in the band at $38\,\mu$ in the far infra-red.

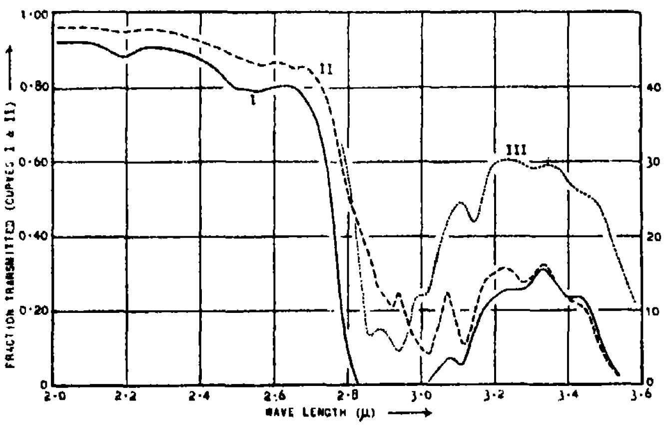

FIG. 1.—Infra-red absorption of quartz. I. Path 63 mm. parallel to axis. II. Path 83 mm. perpendicular to plane of optic and electric axes. III. Galvanometer deflections without specimen.

In curve I the band at $3 \cdot 11\,\mu$ is, I think, to be identified with Dreisch's fourth band, the wave-length of which he does not state. The bands at $2 \cdot 19$, $3 \cdot 27$, and $3 \cdot 41\,\mu$ as well as some structure between $2 \cdot 5$ and $2 \cdot 7\,\mu$ have not, so far as I know, been recorded before. I have also found a band in fused silica at $2 \cdot 23\,\mu$ which is of a similar order of intensity to that at $2 \cdot 19\,\mu$ above. This is interesting in view of Barnes's results (loc. cit.) indicating bands in fused silica in the far infra-red which, it is suggested, are in some way related to bands occurring in crystalline quartz at rather shorter wave-lengths.

Further work on this subject has been unavoidably held up for some months but I hope shortly to carry out a more extensive investigation of the effects using polarised radiation.

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Oct. 17.

[1] *Ann. Phys.*, **55**, 49; 1895.
[2] *Ann. Phys.*, **61**, 687; 1897.
[3] *Z. Phys.*, **42**, 426; 1927.
[4] *Phys. Rev.*, **39**, 562; 1932.

Electrical Ignition of Explosive Gaseous Mixtures

PROF. TAYLOR-JONES, in discussing the thermal theory of the electrical ignition of explosive gaseous mixtures, states that "There is nothing in the thermal theory . . . to suggest that the energy of the translational motion of the molecules, or that of their rotational or vibratory motion plays a preponderating part in the process of ignition" ("Induction Coil Theory and Applications", Pitman, London, 1932). Whilst in complete accord with the first part (up to and including "theory") I cannot agree with this statement as a whole, for the following reasons:

The thermal theory of electrical ignition has been put forward by Taylor-Jones, Morgan and Wheeler[1] in terms stating that "the ignition of a gaseous mixture depends primarily . . . on the heating of a sufficient volume to a sufficient temperature". But this view must involve the supposition that internal molecular energy plays no rôle in ignition, because it is well known that molecules can be excited without at the same time necessarily increasing their translational energy. Thus Taylor-Jones's statement as quoted above should be amended to read "The thermal theory asserts that only the translational energy of the molecules plays a part in ignition", because it cannot be supposed that the ratio between excited and normal molecules in a gas is determined solely and in all circumstances by the temperature.

There are, however, many well-established facts, such as, for example, the photo-ignition of hydrogen-chlorine mixtures, which suggest that internal molecular energy does in fact play a preponderating rôle in ignition and thus appear to contradict the view of the importance assigned by the thermal theory to translational energy. Further, in conjunction with H. H. Thompson[2] I have shown by a crucial experiment that fact and the thermal theory are in direct conflict.

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Nov. 22.

[1] *Phil. Mag.*, **43**, 359.
[2] *Proc. Roy. Soc.*, A, **134**, 343.

Surface Tension near the Critical Point

IT is well known that when measured values of surface tension are plotted against the temperature a nearly linear law is obtained, but that as a rule the curve is concave upwards and approaches the critical point almost tangentially (even if not quite so) the

surface tension being then zero. It must be borne in mind, however, that this statement is made with respect to the 'measured values'. Those, near the critical point, are usually made by means of the capillary tube method and it is tacitly assumed that if the tube is narrow enough to be considered a 'narrow tube' at ordinary temperatures it will still be so at high temperatures.

The principles of dynamic similitude show, however, that this is not the case. The shape and elevation of the meniscus depend not on the radius r alone but on its relation to β where β^2 (the capillary constant) equals σ/gp. In fact β^2/r^2 = function of h_0/r where h_0 is the capillary rise at the mid-point of the tube. The observed quantities are h_0 and r and from these β^2 must be calculated. Now when β is large compared with r (and therefore h_0 is large compared with r) the tube can be considered as narrow and β^2 can be calculated by a very simple relation. But near the critical point β^2 and h_0 are

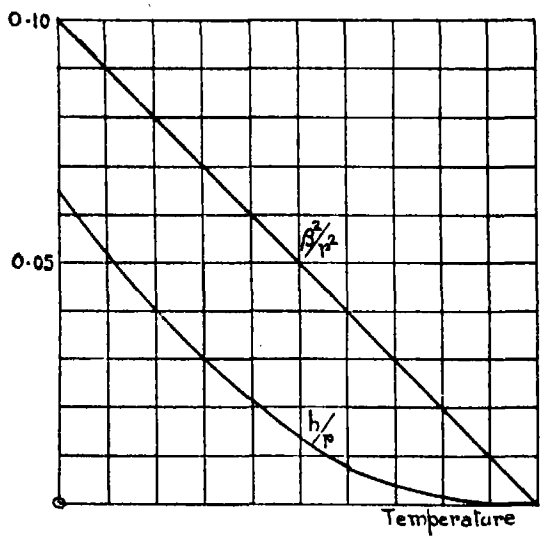

FIG. 1.

very small; the tube now behaves as a very wide one. The functional relation is in such a case much more complicated and it is only since Rayleigh's paper of seventeen years ago[1] that it has become possible to calculate β^2 from the experimental observations.

The most important of these observations were made by Ramsay and his co-workers and published so far back as 1893 in the *Philosophical Transactions of the Royal Society of London*. We may be quite certain, therefore, that the only corrections made were those suitable for a narrow tube. If so, the values which are usually quoted and discussed are really values of $\frac{1}{2}h_0/r$ (or of some quantity very near thereto) and it is to these that the various properties discussed by Baron Eötvös and others relate.

With the help of Rayleigh's equation for very wide tubes it is possible now (and has been for the last seventeen years) to make a proper reduction of the experimental values. This I have done for the special case in which β^2/r^2 is assumed to be a strictly linear function of the temperature. The result is shown in Fig. 1, which is drawn to scale. The values of h_0/r have been calculated from β^2/r^2 (by working backward) and are shown on the lower curve. It will be seen at once that this lower curve *has precisely the characteristics which are usually attributed to* β^2 or rather to the values of surface tension calculated from it.

This suggests that it is quite possible that β^2 is a linear function after all; but it is necessary first to find out (if possible) what were the radii of the tubes actually used by various investigators. This preliminary note is written as a warning to those who, like myself, have spent much time in connexion with this question.

The curve shown has very wide applications. The quantities β^2/r^2 and h_0/r are both pure numbers and a single pair of curves gives the relation between the two sets of values. If, for example, $h_0/r = 0{\cdot}03$ (whether for narrow or wide tubes) then β^2/r^2 at the same temperature has the value 0·07 which is on the same vertical. The *scale* of temperature is adjustable and is therefore not indicated on the diagram. If by altering this scale the experimental values of h_0/r fit the lower curve exactly, then at the same time the values of β^2/r^2 will fit the upper curve. The altered scale need not be simply proportional to the old one; it can be any function of it: but this generalisation need not be further insisted on in this note.

While writing upon surface tension, I may point out that if cream be poured locally on fruit salad and sugar be sprinkled on the exposed parts of the juice, the cream rushes up to meet it; thus showing that the surface tension is increased by adding sugar.

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[1] *Proc. Roy. Soc.*, A, **92**, 184; 1915.

Partial Molecular Polarisations in Solutions

THE dielectric polarisation P_{12} of a mixture of two liquids S_1, S_2 is given by :—

$$P_{12} = \frac{\epsilon - 1}{\epsilon + 2}\,\frac{c_1 M_1 + c_2 M_2}{d},$$

where ϵ is the dielectric constant, c_1, c_2 the molar fractions and M_1, M_2 the molecular weights of S_1 and S_2, and d the density of the solution. Since this quantity has the dimensions of volume, it would appear that the partial polarisations of the two components should be determined by methods similar to those used in evaluating partial volumes, etc.

It has usually been assumed that in solutions containing polar and non-polar components, the molecular polarisation of the non-polar component can be given a constant value P_1, in which case the polarisation of the other component is given[1] by :

$$P_2 = \frac{P_{12} - c_1 P_1}{c_2} \quad . \quad . \quad . \quad (I)$$

The true value of the partial molecular polarisation $\bar{P}_2 = (\delta P_{12}/\delta n_2)$ may be evaluated by the method of intercepts.[2]

Both methods give the same value for a substance present in small concentrations and also when the $P_{12} - c_2$ curves do not diverge greatly from a straight line. If the curve has a maximum, or a point of inflexion, the values of P_2 and $\bar{P}_2$ calculated in these ways may differ considerably. Fig. 1 shows (1) the experimental $P_{12} - c_2$ curve of solutions of *n*-butyl alcohol in heptane[3], curves (2) and (3) the approximate values of P_2 and $\bar{P}_2$ determined by (I)

and by the method of intercepts; (4) is the constant value of P_1 assumed in calculating P_2 and (5) the values of $\bar{P}_1$ determined by the method of intercepts. In this case the assumption that P_1 can be taken as constant is evidently far from true. It may also

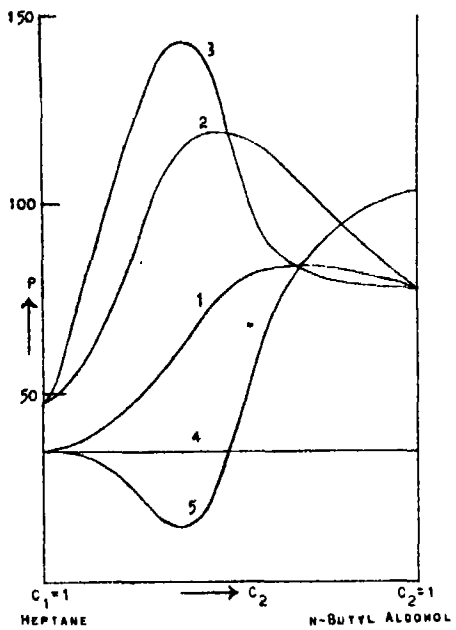

FIG. 1.

be observed that the positions of the maximum of the curves of P_1 and P_2 are considerably different.

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[1] Debye, "Polar Molecules".
[2] Lewis and Randall, "Thermodynamics", p. 38.
[3] Smyth and Stoops, *J. Amer. Chem. Soc.*, **51**, 3318; 1929.

Colour Changes in Crustacea

COLOUR changes, in response to light and darkness and to background tint, are well known in prawns and shrimps. I have found this faculty to be present in other decapod Crustacea. It is exhibited by *Porcellana longicornis*, *Eupagurus bernhardus*, young *Galathea strigosa* and *G. dispersa*, and in two cases referred to below.

It has been shown by Hogben and his school[1] that colour change in Amphibia is due to two causes. (1) Light acts directly on chromatophores (primary effect), and (2) light reflected from the surroundings acts through the eyes, causing the liberation of hormones into the blood, which in turn act on the chromatophores (secondary effect). In the Decapods there appears to be a similar dual control of the chromatophores. (1) Primary effect: light, acting directly on the chromatophores, can cause expansion of the pigment, while in the absence of light the pigment is contracted.[2] (2) Secondary effect: light reflected from a light-coloured background acts on the eyes with the result that a hormone, contractin, is liberated into the blood from glands in the eye stalks. This hormone causes pigment contraction in the chromatophores.[3] A black background, through optical stimulation, causes another hormone, expantin, to be liberated from the rostral gland, with resulting pigment expansion.[4]

Experiments which I have made show that hermit crabs also exhibit this dual control of the chromatophores. The responses of *Eupagurus prideauxi* are as follows. (*a*) In darkness the crabs become pale (primary effect). (*b*) On a dark background in light they become dark (secondary effect). (*c*) On a light background in a dull light they become pale (secondary effect). (*d*) On a light background in a bright light they become dark, although not so dark as in (*b*) (balance between primary and secondary effects). Now, the chromatophores on the abdomen and its appendages are functional, although they are concealed within the mollusc shell. When crabs carrying their shells are on a light background in a bright light (*d*, above) the abdominal chromatophores are less expanded than those on the rest of the body. But when such crabs are removed from their shells, light can act directly on the abdominal chromatophores, and within a few minutes they expand as fully as the others.

In the shore crab (*Carcinus mænas*) dark-coloured adult individuals exhibit no colour changes, but light-coloured animals show a small amount of colour response. Most young individuals (1–2 cm. across), however, exhibit colour responses to backgrounds and to darkness within 30 minutes. As the crabs age, this faculty is gradually lost, individuals of 2–4 cm. requiring one or more days to react. In the dark-coloured adults, which do not change colour, most of the chromatophores beneath the carapace are expanded. Blood from these crabs injected into prawns usually causes them to darken, showing that an excess of expantin is present. Now, the removal of the contractin glands in *Crangon* has been found to cause the calcium content of the shell to diminish, suggesting that contractin is concerned with calcium deposition.[5] It is possible that the scarcity or absence of contractin in adult *Carcinus* may be connected with the deposition of salts in the thick exoskeleton. In Amphibia, too, there is a connexion between calcium metabolism and colour change. The pars tuberalis of the pituitary is concerned with the colour response of these animals to white background.[1] Now, a fall in blood calcium following pituitary removal occurs in Amphibia,[6] and in a private communication Prof. Hogben writes that Dr. Zwarenstein, working in his laboratory, has recently proved this fall in calcium to be due to the removal of the pars tuberalis.

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[1] Hogben and Slome, *Proc. Roy. Soc.*, *B*, **108**, 10; 1931.
[2] Keeble and Gamble, *Phil. Trans. Roy. Soc.*, *B*, **196**, 295; 1904.
[3] Perkins, *J. Exp. Zool.*, **50**, 71; 1928.
[4] Koller, *Z. vergl. Physiol.*, **8**, 601; 1928.
[5] Koller, *Z. vergl. Physiol.*, **12**, 633; 1930.
[6] Hogben, Charles and Slome, *J. Exp. Biol.*, **8**, 345; 1931.

Tables for Statisticians and Biometricians, Part II

As some readers of NATURE may have purchased copies of Part II of the "Book of Tables for Statisticians and Biometricians", recently issued from this Laboratory, I should be glad to inform them through the columns of this journal that copies of an errata slip may be obtained post-free on application to the Secretary of the Laboratory.

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Research Items

The Severn Crossing in Roman Times.—During the course of the present year Dr. C. Scott Garrett and Mr. Frank H. Harris, 23 Newerne St., Lydney, Glos., have discovered the foundations of extensive Roman buildings in three fields known as the 'Chesters' on the land between the Severn and Woolaston Pill. In a communication sent to NATURE they suggest that this gives ground for a revision of the current idea that the Roman station of Abone was Sea Mills on the Avon. This identification is supported by Haverfield, Collingwood and the Ordnance Survey map of Roman Britain. It must be remembered that the water level of the Severn was considerably higher in Roman times than it is now, and even to-day the low land behind Caerwent is sometimes flooded, so that the station itself must have been very near to the water when it was built: of this there is abundant archæological evidence. On the other hand, the erosion on the right bank of the river has been so extensive that only half of Sudbrook camp remains. But this loss has been more than compensated for by the deposition of alluvium on the left bank. Supposing that the Severn once flowed not far from the foot of Shirehampton Hills, then the Roman port was probably either at Sea Mills or on the Severn just to the east of it because the Roman road from Bath to Bitton and on to the north crossed Durdham Downs in the direction of Sea Mills, and if the point of departure had been elsewhere, for example, at Oldbury, it would have been as easy for the road from Bath to go there direct as via the Avon. A road from Sea Mills to Gloucester is marked on the ordnance map, but this would have been an indirect approach to Oldbury, unlike the usual Roman method of road planning. It has long been known that there was a Roman station at Sea Mills, and when the Portway, the new low level road along the Avon was cut, a few years ago, a great deal more Roman material, including the foundations of buildings, was discovered. On the whole, this site fits well into the position of Abone given in the itinerary of Antonine, though the problem of "Trajectus" has been variously solved by scholars. However, no more distant site would meet the requirements of the twenty-four miles allowed between Bath and Caerwent.

The Wynad.—In "Notes on the Cultural Geography of the Wynad" (*Indian Antiquary*, Sept., Oct., 1932), Mr. F. J. Richards reviews the history and ethnology of the Wynad, which forms the southern bastion of the Deccan plateau. The plateau is hemmed in by the Coorg Hills on the north and the Nilgiris on the south. By its natural features the country is divided up into areas which differ from one another in their cultural affinities. On the Malabar borders it is densely forested, while on the Mysore border is a broad deciduous bamboo belt. An area of about 1,100 sq. miles supports a population of a little more than 100,000. The Wynad has never been studied intensively from the anthropological point of view. Before the introduction of tea and coffee planting, the population was mostly confined to swampy ground along the river valleys, growing paddy. They had no use for the forest land, all the pasture required being provided by the low hillocks which grow from the swamps. Each river valley supported a more or less homogeneous community. The oldest stratum in the population is, presumably, the curly-headed Paniyar, speaking corrupt Malayâlam, whose method of fire-making by 'sawing' links them with the jungle folk of Malaya. The Ten Kurumbars and Shola Nâyaks are more purely jungle folk, speaking Kanarese. The Kurrichans are the highest in social standing of all the tribes. They cultivate their own lands and are keen fighters and hunters. The evidence of language and tradition pointing to Malabar influence is supported by the 'forelock' in the style of hair-dressing and by the dress. The land-tenure is also modelled on Malabar. The Wynad religious cults are clearly imposed on something older. The area abounds in evidence of an earlier populous civilisation, historic and 'prehistoric'. The present depopulation may be due to the malaria of the bamboo belt.

Madras Plankton.—In a preliminary account of the plankton of Madras, K. S. Menon (*Rec. Indian Mus.*, vol. 33, pt. 4, 1931) gives a list of the principal organisms met with. He states that while a few genera, for example, *Sagitta* and *Pleurobrachia*, show little variation in numbers throughout the year, most of the organisms in the plankton exhibit periods of maxima and minima. This seasonal variation is not so clear-cut as in the European records; for example, many of the copepods have a definite maximal period but are scarcely ever absent. This is probably because the weather conditions and changes in the constitution of the sea-water vary less than in colder seas. The plankton of the west coast of India, as recorded by Hornell and Naidu, shows great scarcity of diatoms in December, a secondary maximum in January and February, a fall in March and the principal maximum in May. In the Madras plankton, diatoms are scarce in August and September; the secondary maximum is from November to January and is made up mainly of *Coscinodiscus*. The true phytoplankton maximum is in May; diatoms become fewer in June but in July reappear in large numbers and then disappear rapidly. There is no separate dinoflagellate maximum; it coincides with the diatom maximum in May. The copepod maximum is from November to February inclusive; the difference between this and the condition in European seas is the inhibiting factor of cold in the latter.

Primitive Conducting Mechanisms of the Vertebrate Heart.—Employing as research material larval *Lepidosiren paradoxa*, Dr. Tudor Jones has published an important paper on this subject (*Trans. Roy. Soc. Edin.*, vol. 57, 1932). He has shown that all the conducting mechanisms hitherto described are here represented by purely nervous structures, and that their appearance preceded the general development of cardiac muscular striation. The entire system has been traced out and shown to consist of a nervous continuum consisting of two regions of the medulla oblongata, intermedio-lateral and ventral, with communications involving the sixth aortic arch, the ductus Botalli, the pulmonary artery, the sinus venosus, atria and ventricles of the heart, and, finally, the pulmonary vein. There are also bilateral communications at three levels which are probably of segmental origin. These structures form, at the cardiac end, a nervous complex to which, Dr. Jones

believes, the whole development of the heart may be referred "as to an organic system of developmental foci". It is of great interest to learn that structures, such as the sixth aortic arch, the ductus Botalli, the pulmonary artery and the heart, which were not previously known to be related, are actually so related by their fundamental *innervation*.

Biochemistry of Sea Life.—In a paper, compiled for a symposium at the Pasadena meeting of the American Association ("Life in the Ocean from a Biochemical Point of View". *J. Washington Acad. Sci.*, **22** (9), 246–257, 1932), Paul S. Galtsoff deals with the importance of certain minor constituents of sea water for plant growth and tabulates the concentrations of the elements in the sea, so far as they are known, also the ratio of the concentration in tissues to that in sea water. The high concentration of zinc in tissues, up to 10,000 times the amount in sea water, is noteworthy. Mention is also made of Prytherch's work upon the effect of traces of copper in river water in stimulating oyster larvæ to become attached. Interesting temperature effects have also been quoted. The paper might profitably be read by all interested in marine life.

Biological Significance of Colloidal Structure.—The structure of the protein is considered very suggestively from the biological point of view by Dr. D. Jordan Lloyd in *Biological Reviews*, vol. 7, No. 3, July, 1932. The high content of water in actively growing protoplasm is emphasised. This water is a necessity if the metabolic reactions associated with vital activity are to proceed in solution and it is pointed out that the proteins in the living protoplasm probably have highly hydrated polar amino-acids linked to the CH–NH–CO backbone, which itself supplies an element of stability to the structure. The water relation of such a protein system would be highly sensitive to changes in environment. On the other hand, in both plant and animal tissues, fibrous structures are present, constructed of protein in the animal and of carbohydrate in the plant, which are essentially stable and have a low water content. In these fibres the stable backbone of the long-chain chemical structure, which is itself little hydrated, has linked to it comparatively few polar side chains with strong affinity for water, but it is built up of a series of stable ring linkages following one another with periodic regularity, so that X-ray analysis can be employed to unravel their structure. Such structures combine stability and resistance to decay with a low water content and slight affinity for water. Thus from the same colloidal systems structures may be built meeting the very diverse needs of living organisms.

A Disease of Dahlias.—A leaf-spotting disease of dahlias occurred at Wisley in 1930. It was studied in detail by Mr. D. E. Green, who now reports the results of his investigations (*J. Roy. Hort. Soc.*, vol. 57, pt. 2, pp. 332–339). Detailed descriptions of the symptoms are given, and the causal fungus has been identified as *Entyloma dahliæ*, Sydow. Various control measures have been tried, and some success has attended the use of Bordeaux mixture used as a spray in August. French growers state that late planting aggravates the disease. No satisfactory demonstration of the way in which infection spreads in the field has been given, and preliminary experiments on direct infection with spores have not produced the disease. Further work is in progress to try to find how the fungus overwinters.

Dipterocarpaceæ of the Malay Peninsula.—From a commercial forestry point of view, the group of Dipterocarpaceæ contains some important timber trees, and yet the knowledge of them so far attained is said to be very incomplete. Mr. H. N. Parker has been studying the Indian and Burman species at the Forest Research Institute, Dehra Dun, and Dr. F. W. Foxworthy, the forestry research officer of the Federated Malay States, has been undertaking investigations in the group in the Malay region, where it forms so important a portion of the forest flora. This work appears in *Malayan Forest Records* (No. 10, Singapore, pp. 289, plates 33 and map, 1932). Dr. Foxworthy states that the knowledge of the group remains very incomplete, in spite of the fact that it contains the most important group of timber trees of the Malay States. Attention has often been directed to the difficulty of obtaining herbarium material because of the very large size of the trees, the scarcity of population in the forests, and the relatively infrequent flowering and fruiting of many species. There have been but few botanists specialising in the group, and collections, until recent years, have been few. The author has worked at the group for a number of years and has had the opportunity of examining types and critical material in the herbaria of Leyden, Kew, Calcutta, Singapore, Buitenzorg and Manila. Dr. Foxworthy's untiring labours have added very considerably to our knowledge of the Dipterocarpaceæ.

Solar Influence on Cosmic Radiation.—The Bauer memorial number which constitutes the September issue of *Terrestrial Magnetism and Atmospheric Electricity* contains a short contribution by Prof. Hess of Innsbruck describing the cosmic radiation observatory he has set up on the Hafelekar at a height of 2,300 metres above sea-level. The apparatus is of the same type as that in use at the other observatories which are taking part in the co-operative plan of work organised by Prof. Hess, a list of which was given in a note in NATURE of November 26, p. 816. The ionisation chamber contains 22 litres of carbon dioxide at 9·5 atmospheres and the ionisation current to the electrometer is compensated as in Hoffmann's apparatus. The records are taken photographically and from September last year until May this year they show that the ionisation during the day is about 0·2 per cent greater than during the night.

Mechanism of Gaseous Explosion.—The November issue of the *Proceedings of the Royal Society* contains two papers on the mechanism of explosive oxidation in the gas phase. One by Hadman, Thompson and Hinshelwood describes experiments on dry carbon monoxide in silica vessels at temperatures around 700°. There is an upper and a lower limit to the pressure range over which explosion takes place, and the reaction goes on slowly outside these limits. The lower limit does not depend markedly on the temperature; its dependence on the size of the reaction vessel is apparently masked by other differences in the

vessels. It is lowered by the presence of inert gases. The upper limit rises rapidly with temperature. A peculiar effect was obtained when the pressure of a mixture was gradually lowered until it was well inside the reaction limits without explosion taking place. This is said to be due to a 'poisoning' of the walls of the vessel by carbon monoxide. The results are explained on the basis of a reaction which starts at the surface of the vessel and proceeds by a chain of reactions. The lower limit is then determined by the diffusion of active centres to the wall of the vessel and is lowered by inert gases which diminish this diffusion. The upper limit is determined by a de-activation process taking place in the gas phase. The second paper, by Hinshelwood and Moelwyn-Hughes, deals with the hydrogen-oxygen reaction in silica vessels, and describes experiments on the lower limit of pressure for explosive reaction. As with carbon monoxide, inert gases lower this limit, and here there is rough quantitative agreement with the assumption that the inert gas prevents the loss of active centres by diffusion to the wall.

Short Wave Radio Propagation.—In view of the increasing use of short waves for radio communication, any new facts concerning them are of great interest to engineers. In a paper read before the Institution of Electrical Engineers on December 7, Prof. J. Hollingworth gave experimental data obtained by examining signals with a cathode ray direction finder, received at distances up to 7,000 miles, having frequencies of the order of 10,000 kilocycles a second. The work carried out is part of the programme of the Radio Research Board. The two outstanding features noted in the research are the systematic appearance of certain cyclic forms on the end of the tube of the direction finder and the large values obtained for the horizontally polarised electric components. An ellipse, which is generally in a violent state of oscillation, is seen in the tube. This shows that there is an abnormally polarised wave present. 'Fading' gives a change in the size of the ellipse without change of shape. An analysis of the ellipse forms is given based on Appleton's magneto-ionic theory. This theory predicts that in general each up-going ray will be split into two elliptically polarised components with opposite directions of rotation, which recombine on emergence from a layer where they have suffered differential phase change and absorption. The author concludes from the evidence that in general the magneto-ionic theory seems to provide a reasonable explanation of the majority of the observed phenomena. The experiments were originally undertaken in a spirit of pure inquiry but some of the results are so surprising that they inevitably challenge accepted ideas.

Astronomical Topics

The Leonids.—The fullest series of observations yet to hand was made by Dr. V. Guth at Stary Smokovec in Czechoslovakia (height 1,020 metres). He gives in U.A.I. Circular No. 408 the following table of his observations :

U.T.	Nov. 16	Nov. 17	Nov. 18	Nov. 19	Nov. 20
0^h–1^h	16	*cl.*	*cl.*	*cl.*	*cl.*
1-2	42	*cl.*	*cl.*	*cl.*	3
2-3	40	*cl.*	*cl.*	0	5
3-4	57	*cl.*	*cl.*	6	*cl.*
4-5	63	*cl.*	5	3	3

cl. means cloudy or misty.

On the first night there were 15 meteors brighter than mag. 0. One that was seen at 3^h36^m on that night was a detonating meteor, mag. – 5. The above figures suggest that maximum may have occurred during daylight on November 16, which would accord with prediction.

Mr. M. A. R. Khan made the following observations of Leonids at Hyderabad : Nov. 8, 11 in 60^m ; Nov. 9, 5 in 30^m ; Nov. 11, 10 in 60^m ; Nov. 12, 9 in 80^m ; Nov. 13, 2 in 30^m ; Nov. 14, 7 in 60^m ; Nov. 16, 20 in 70^m. Two meteors on Nov. 8, and four on Nov. 16, were noted as bright. The observations were made between 20^h and $23\frac{3}{4}^h$ U.T. on the days named. The nights of Nov. 10, 15, and 17 were cloudy throughout.

Planetary Perturbations.—Prof. W. H. Pickering, in an article in *Popular Astronomy* for November, criticises a paper by Prof. E. W. Brown (*Mon. Not. Roy. Ast. Soc.*, vol. 92, p. 80) in which the statement occurs "From time to time statements have been published . . . that the maximum observable effect of one planet on another will take place at or close to conjunction. How completely erroneous such statements are can be shown . . ." Prof. Pickering distinguishes between the largest perturbations and those of sharpest curvature. He admits that the former take place when the planets are on opposite sides of the sun ; but the wave produced by them is so long that in the case of a planet that has only completed one revolution since discovery they cannot be separated from errors in assumed eccentricity and perihelion point. Those that occur near conjunction of the planets, though smaller, are easier to distinguish from errors of the elements, owing to their more rapid change. Prof. Pickering appears to justify this assertion by recalling the circumstances of the discovery of Neptune. Bouvard, in his tables of Uranus published in 1821 (the year of its conjunction with Neptune), rejected all the observations of Uranus made before its discovery in 1781 ; nevertheless, his tables soon began to exhibit appreciable errors. These were prominently shown in the Cambridge observations of 1828 ; in 1834, the Rev. T. J. Hussey wrote to Airy suggesting the existence of an exterior planet, and offering to search for it if an approximate position could be given. Bouvard himself had the same idea in 1837. Airy admitted in that year that the "errors of longitude are increasing with fearful rapidity", though he had not much confidence that the position of the unknown could be determined ; he said, however, that the facts "tended greatly to impress upon astronomers the absolute necessity of seeking some external cause of disturbance". Prof. Pickering's deduction that an observable effect does occur about the time of conjunction appears justified. It is well known that he tried to deduce from the observations of Neptune the position of an external planet ; he made three different determinations of its position, which were published in 1909, 1919 and 1928 ; the middle one was within 69′ of the true place of Pluto at the time of publication, the others were some 27° away from it. In fact, Pluto was photographed at Mount Wilson in 1919 as a result of that prediction, but the images were not detected until 1930.

The Discovery of Peking Man*

IN his Croonian lecture on *Sinanthropus* or Peking man, Prof. Davidson Black gave a full and detailed account of the circumstances leading up to the discovery of the skeletal and cultural relics of this primitive human type and of the conditions, geological and other, in which they were found.

The first indication of the presence of early man to be found on the site was in 1921 when Dr. J. C. Anderssen, then mining adviser to the Chinese Government, noticed fragments of white quartz among loose talus at the foot of fossiliferous deposits exposed in the south wall of a disused quarry in the Ordovician limestones at Choukoutien. As no quartz of any kind occurs naturally in this part of the Choukoutien area, he at once inferred the presence of primitive man. From this point Prof. Black described the investigations which led to the discovery of a fossil tooth, first announced in 1926 on a report from Uppsala, where material from Choukoutien was under investigation; the discovery of the fossil tooth by Dr. Böhlin in 1927, upon which was based the recognition of a new human genus, *Sinanthropus*; and the discovery of the first and second of the two skulls in 1929 and 1930 by Dr. W. C. Pei, under the Cenozoic Research Laboratory, which was organised by the Geological Survey of China in 1929 and now functions as an integral part of that service. In 1930 the Geological Survey acquired by purchase full title to the *Sinanthropus* site, which is thus preserved to science for all time.

In 1931 Dr. Pei discovered artifacts and evidence of Peking man's use of fire in an undisturbed fire-blackened stratum. Prof. Black also referred to the other skeletal fragments recently described, as well as to six lower jaw fragments, of which an account is to appear shortly. The endocranial cast which has been prepared indicates that *Sinanthropus* was right-handed and possessed a nervous mechanism for the elaboration of articulate speech.

In his account of the conditions of the discovery Prof. Black was on what was probably to most of his audience less familiar ground. Channels and caverns have been hollowed out of the Ordovician limestone by the solution action of ground water; and after the elevation of the formation, erosion removed the overlying strata. Fissures which formed have been filled and these deposits converted into travertine.

The cavern occupied by *Sinanthropus* was large, of irregular shape, and opened towards the river valley to the east. Throughout the time it was being gradually filled by detritus, it was wholly or in part occupied by *Sinanthropus*. His occupation must have extended over hundreds, probably thousands, of years, for more than thirty metres of undisturbed strata remain, showing evidence of his presence throughout. During the later part of his occupation the fauna did not change, but remained typically that of the upper part of the Lower Pleistocene.

Most of the northern limestone wall limiting the original cave has been removed by modern quarrying operations exposing the solidified detritus. Up to 1932, excavations of the actual deposits have been confined to the regions accessible from the northern face. Work is now progressing along the line of contact between the accumulated deposit and the southern wall of the original cave.

The modern cave of Kotzetang is really the result of recent excavation, made probably by quarrymen, in the relatively unconsolidated portion of the great stratified breccia comprising the eastern portion of the main Choukoutien deposit. The northern wall is part of the original northern wall of the cavern.

Prof. Black also referred to the artifacts and the recent study of them by Dr. W. C. Pei and P. Teilhard de Chardin, from which it is concluded that *Sinanthropus*, "culturally speaking, is to be considered as an early representative of the Old Palæolithic cycle, but his craft displays a crudity which indicates that he but obeyed and never mastered the materials with which he worked".

* Substance of the Croonian lecture delivered by Prof. Davidson Black before the Royal Society on December 8.

Capacitance Hygroscopy and some of its Applications

By Dr. W. LAWRENCE BALLS, F.R.S.

SOME experiments were briefly noted in this journal last April[1] whereby the high dielectric constant of water was used to indicate variations in the water-content of substances contiguous to a leaky condenser, by means of a resonance method. It would seem that other workers are exploring the same track, with the difference that they draw samples which are placed in special condenser-containers for measurement, whereas I prefer to take full advantage of the method in evading the ubiquitous 'sampling-error' so far as possible; even at the sacrifice of some accuracy in the actual determination. Great accuracy is probably unobtainable in any case; the dielectric constant even of free water is not a constant, but the margin of difference between water around 80 and most other common substances below 8 is large enough for most classes of comparative work.

The necessary apparatus is as portable as an attaché case, and is proving itself to be of versatile utility. Examples will shortly be given. On the analogy of resistance thermometry, I suggest that the general technique might be termed 'capacitance hygroscopy'.

The arrangement at present used is necessarily capable of improvement in electrical design, but it functions very usefully when its limitations are respected, especially since the discovery of papers by Lattey and his collaborators has allowed voltage-tuning to be incorporated.[2] This is done by applying the resonator voltage to the grid of a second valve, the anode current of which then indicates the voltage, as in the Moullin thermionic voltmeter[3]; the coupling between the generator and resonator can be kept very loose, and a feeble and portable generator used with safety. The triple circuit shown in Fig. 1 is also a plan of the arrangement. It undergoes small zero shifts due to temperature and also to earth-capacity, but these are eliminated by zero-setting with one variable condenser, prior to measurement on the

other one. Variations of resistance in the unknown capacity can also alter the 'capacitance' readings, in spite of voltage tuning, as Lattey has recently pointed out; the elimination of these errors is no doubt possible, but even now it is practicable to obtain accurately comparative readings in repetition work, the voltage indications serving as a warning of abnormal conditions. Definite fixation of frequency by a quartz crystal, capacity coupling, and proper screening, are obvious improvements next to be made.

Three examples of very diverse applications will now be outlined.

SOIL-WATER DETERMINATIONS

The buried condensers are, as formerly described, made from purchased glass web-tube, or from home-made capillary web-tube produced by blowing two bulbs together and then drawing them out. Staybrite steel wire (33 s.w.g.) is used for the final lead-in, to avoid amalgamation. Gutta-percha seals these wires in the entrance to the web-tube. The larger tubes are wrapped in a thin skin of cotton fabric dipped in plaster of Paris, so as to stabilise the capillary water conditions in contact with the glass; an assumption is made here. The leads are made of thin widely-spaced wires inside gas-pipe, so that they may be as insensitive as possible to the soil-water variations until the web-tube is reached at depths of three metres or so, but their design is not yet properly worked out.

Some very complex curves for changes in soil-capacity with changes of moisture have recently been published,[4] determined by a compensated bridge method. They contrast very sharply with such simple curves as Fig. 2, which seem to me to be more inherently probable. Actually even these latter

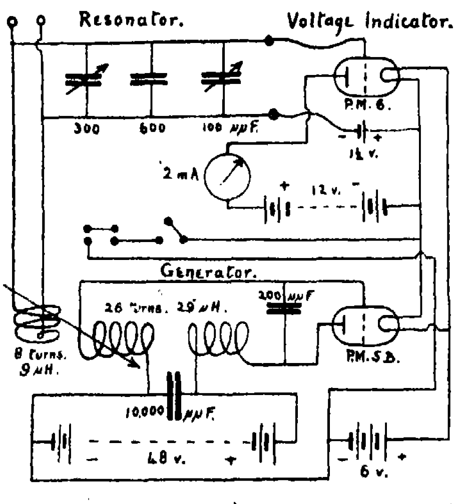

FIG. 1—Circuit diagram and plan. $\lambda = 150$ m.; $f = 2000$ kc.; $\delta = 0{\cdot}06$. Size: 12 cm. × 32 cm. × 38 cm. Weight 8 kgm.

are more complex than those obtainable in deep soil, because the capillary web-tube condensers were buried initially in air-dry soil which was allowed to swell freely on saturation with water, and then to shrink into a compact block as it dried. In the field one would not obtain the volume increase except near the surface. The inflection shown by both curves, representing two separate experiments, near the point at which deep soil becomes water-logged in the field,[5] marks the upper limit of capacitance under deep soil conditions. The fragment of hysteresis loop obtained after oven-drying and slowly damping again by exposure to air, is probably also abnormal in width, owing to minute air-space cracks developing between the soil and the bare capillary glass.

TESTING COTTON BALES

As president of the Trustees of the new Alexandria Testing House, founded in consequence of an international trade agreement. I have been given exceptional facilities by the pressing firms of Alexandria,

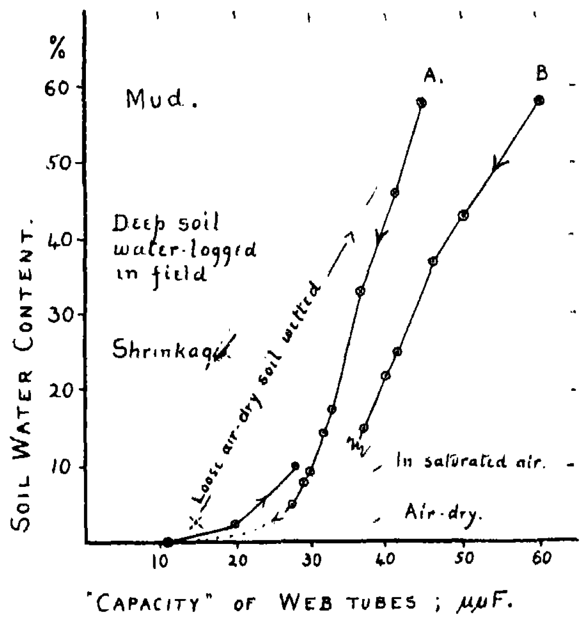

FIG. 2. Soil moisture.

to obtain data from bales specially prepared to various moisture contents, while Mr. D. A. Newby has collaborated in making the oven tests more exact. Capacitance tests are now being taken as routine on the hoops of all bales from which oven-tests are to be made, so as to accumulate several hundred pairs of observations. It already seems likely that so long as the test is limited to freshly pressed and homogeneous bales, as formerly suggested, we have a useful and rapid method of control which can test every bale made, and can do so at much less cost than the usual oven-testing of every tenth bale. Whether it can be trusted to the extent of dispensing with oven-tests at the press-foot remains to be seen.

I excluded the non-homogeneous bale from the original scheme of possible capacitance tests, but the finding of a solution for the special problems created by the presence of a wet or dry outer layer, or even more complex distributions of water in depth, is most alluring. It now appears that differential testing at various depths can be done by altering the grouping of the bale hoops upon which contact is made when the attaché case is hung on the bale. Fig. 3 shows how the drying of the surface during hot dry summer weather, from one day to another, is much more noticeable when successive hoops are 'contacted' (2,4,6 v. 3,5) than when deeper penetration of the field of force is secured by missing out three intervening hoops (2.10 v. 6). Such a figure is also a

nomograph for determining moisture content. The case is analogous to resistance measurements in geophysics, but the curve of penetration seems unfortunately to be much flatter.

An incidental fact is that the 'capacitance' observed by our system of using the bale-hoops themselves as condenser 'plates' is almost exactly proportional to the volume of the triple dielectric—air, cotton, water—and not to its thickness. A similar departure from convention is shown by the capacitance of 'hoops in air', namely, a bale-skeleton of hoops spaced out on thin wooden rods: the capacitance of a few wide-spaced hoops is markedly higher than it should be in relation to the reading from close-spaced hoops.

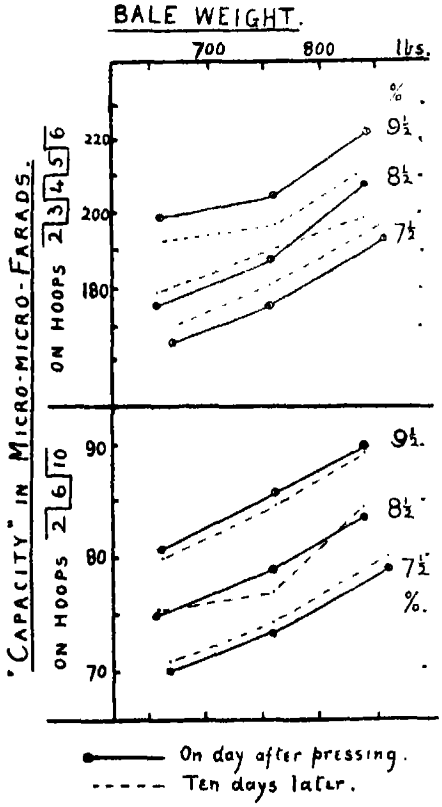

FIG. 3. Cotton bales.

A trial of the method at Manchester Docks on a day when the weather was typical for the locality, using a hoop-grouping which tested only the surface of the bale, gave the interesting result that the surface moisture content was so high as to be off-scale, although the average of the whole bale when oven-tested was near normal. The bale had gained two pounds in weight since being taken off the ship. The demonstration was a failure from the spinner's view-point, but very successful from the exporters'.

INDICATING THE GROWTH OF CROPS

It is common experience that the capacity of a radio antenna is increased by the increasing proximity of branches of trees, but we are not aware that the phenomenon has been used in the inverse direction, to measure the growth of the tree.

Some small scale experiments in my English garden, made chiefly on the exceptionally difficult subject provided by a grass lawn, show that the capacitance hygrometer apparatus is usable to give instantaneous readings of the changes in capacitance consequent on increased water-content due to enlargement by growth. Two forms of 'condenser' have been used, the first being bare wire netting half a metre square, supported on insulation at 5 cm. above the surface of the lawn, with a counterpoise earth of similar netting below it, pegged down firmly; the grass and clover grew through this lower plate of the condenser, the capacity of which rose as shown in Fig. 4, evidently following the varied weather of the period, and the final removal of one-fifth of the grass with a hot iron.

Such arrangements of bare wire suffer from instability, on account of defective insulation, especially when water-drops are present after rain or dew. This is more easily examined by using miniature antennæ of wires stretched under constant tension. If rubber-covered wires are used, including a counterpoise wire, the 'capacity' observed is inversely as the voltage, due to dielectric absorption.

A workable arrangement consists of three such wires, each 3 metres long. One is pegged firmly down to the surface of the freshly mown lawn as a counterpoise, the other two supported above and parallel, forming an equilateral triangle in end view, of 3 cm. side. The field of force between the two upper wires on one hand, and the counterpoise on the other, passes through the growing grass; the initial capacity is about 100 μμF., and may rise as much as seven or eight μμF. in a day. From this starting point we can design longer and more widely spaced antennæ, and it should be a simple matter to string such antennæ across a field of growing crops; the reading could be made continuous by coupling my universal recorder to the condenser dial and operating it by a contact on the milliammeter; the decrement of the circuit as well as the capacity would thus be recorded. The method seems eminently suited to cereal crops, which have hitherto presented serious difficulties in growth-measurement. As before, the sampling error becomes trivial.

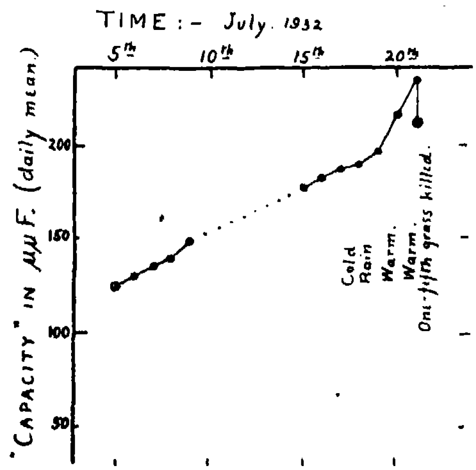

FIG. 4—Condenser of wire-netting on a grass lawn.

In all such arrangements it is evident that the capacitance increment for a given volume of growth will change progressively, so that it would be difficult to establish a quantitative relation over long intervals of time. But this is relatively unimportant, since long-period growth is obtainable by cruder methods;

the discrimination between growth-rates on successive days is easy, and this has been the difficult part of field-growth measurement.

An extensive publication of the results obtained in the many thousands of readings which have been taken by this method during the past year does not seem justifiable, since so many of them have been devoted to elucidating electrical difficulties which could probably have been solved *a priori* by a more competent worker. Some detailed publication on the special case of the cotton bale will in any case be necessary, on account of its commercial importance. On the other hand, it is clear, from letters received, that the application to soil alone is of interest to an unexpected variety of scientific students. Therefore it seemed desirable to put together an outline of all the essential facts, difficulties and limitations thus far encountered, so that other workers may be able to develop the application of the technique to their own special problem, and yet may realise that such application is in itself an experimental investigation of the technique and of its many side-issues. The method is qualitative rather than quantitative, and is best used under standardised conditions, until such time as it is more fully worked out; meanwhile, advice and independent effort in so doing would be welcomed.

[1] W. L. Balls, NATURE, **129**, 505, April 2, 1932.
[2] For example, Lattey and Davies, *Phil. Mag.*, **12**, 1111; 1931.
[3] Moullin, E. B., "Radio-Frequency Measurements". Griffin, London, 1931.
[4] *J. Agric. Sci.*, 1932.
[5] W. L. Balls, *J. Agric. Sci.*, 1913.

University and Educational Intelligence

BIRMINGHAM.—At a meeting of the Council on December 7 the Pro-Chancellor (Sir Gilbert Barling) announced a generous gift by Lady Barber, widow of Sir Henry Barber, founder of the Faculty of Law in the University. The benefaction consists of securities providing an annual income of about £12,000, to be devoted "to the provision of an Institute of Fine Arts in the University; to the advancement of music and musical education in the University, and to further developments in the Faculty of Law which was brought into existence by the founding of the Barber Chair of Law". The deed of trust provides for the erection of a building on the University site at Edgbaston to include galleries for exhibition of works of art, a chamber for musical recitals, and a musical department with a library and a museum for the accumulation of musical manuscripts.

The Pro-Chancellor, Sir Gilbert Barling, has announced his intention of retiring from office at the end of the year. Sir Gilbert Barling, who succeeded the first Vice-Chancellor (Alderman C. G. Beale) in 1913, has an extraordinary record of personal service to the University, in which, at the age of seventy-seven years, he still takes a very active interest.

A grant of £50 has been made from the Lapworth Research Fund to cover the cost of cataloguing pamphlets, maps, etc., of the late Prof. Lapworth for the Lapworth Library of the Department of Geology.

LONDON.—The Mercers' Company and the Fishmongers' Company have decided to make grants to the University in the shape of annual payments extending over a series of years and amounting in each case to a total of £10,000. These gifts will be applied by the University towards meeting the cost of the new Ceremonial Hall to be erected on the University's site in Bloomsbury.

THE Institution of Naval Architects scholarship, valued at £130 a year for three years, will be offered for competition in 1933. This scholarship is open to apprentices under the age of twenty-three years, from the royal dockyards or private shipyards, and is tenable at the Royal Naval College, Greenwich, or the Universities of Glasgow, Durham (Armstrong College) or Liverpool. Full particulars may be obtained from the Secretary of the Institution of Naval Architects, 2 Adam Street, Adelphi, London, W.C.2.

THE twenty-first annual Conference of Educational Associations will be held at University College, Gower Street, London, W.C.1, on January 2–9, under the presidency of the Right Hon. the Earl of Athlone. On January 2 there will be a joint conference on "The Trend of Education" at which Mr. H. Ramsbotham, Parliamentary Secretary to the Board of Education, Miss W. Mercier, principal of Whitelands College, and Mr. J. E. Barton, president of the Association of Head Masters, will speak.

Calendar of Geographical Exploration

Dec. 21, 1605.—Torres Strait

Pedro Fernandez de Quiros, accompanied by Luis Vaez de Torres in a second ship, left Callao. Quiros, while pilot on a previous expedition to the Santa Cruz group, had become fired with the idea of a great southern continent, thought by him to lie near Santa Cruz. Quiros passed through the centre of the Low Archipelago, thence north of Samoa and the Fiji group and finally discovered Espiritu Santo in the New Hebrides. Quiros then returned, but Torres continued, discovered the strait named after him and proved the insularity of New Guinea. His discoveries passed unheeded at the time, but after the capture of Manila in 1762, his narrative fell into the hands of Alexander Dalrymple and the value of his work was realised.

Dec. 21, 1835.—Exploration of Oman

Lieuts. Wellsted and Whitelock reached the fertile district south of Jabal Akhdar, the main range of Oman. There they were astonished to see "verdant fields of grain and sugar cane . . . and streams flowing in every direction". Wellsted was the first to explore this south-eastern corner of Arabia scientifically and was, for part of the time, assisted by Whitelock. Political disturbances prevented Wellsted from crossing the desert to Nejd and he returned to India in 1836.

Dec. 23, 1558.—An English Trader in Russia

Anthony Jenkinson reached Bukhara. He was a trader who had travelled in the Levant and went to Russia in 1557. There he set out from Moscow, reached the Volga and sailed down it to the Caspian, making a rough survey of the north of that sea. Thence he travelled to Bukhara, where he spent three and a half months, returning to England through Russia. In 1561 he went to that country again and, following a route along the west of the Caspian, reached Kazvin, the capital of Persia, in October 1562. Though his journeys did much to increase our knowledge of Russia, and the lands to the south-east of it, English trade via that route ceased in 1581, thus giving an impetus to voyages in the Levant.

Societies and Academies

LONDON

Geological Society, Nov. 23.—**A. E. Mourant**: The geology of eastern Jersey. The area described includes the whole of the Jersey volcanic series and certain associated rocks. The oldest formation in the island is the Pre-Cambrian shale series, consisting of grey mudstones and shaly grits. This is succeeded, with a slight unconformity, by the volcanic series, the field relations and petrographic characters of which are described. The volcanic rocks of northern Brittany differ in some respects from those of Jersey. Reasons are given for regarding the Jersey volcanic rocks as Pre-Cambrian. The field relations of the plutonic rocks of the area are discussed.—**E. Willbourn and F. T. Ingham**: The geology of the Scheelite mine, Kramat Pulai Tin Limited, Kinta, Federated Malay States. There are a number of occurrences of scheelite ore at Kramat Pulai, one of them of considerable dimensions, and the ore is of unusual character, being a coarse-grained intergrowth of fluorite and scheelite, with less than one per cent of other minerals. The granite which built up the great main range of the Malay Peninsula was the source of the ore, as it was also of the rich tin deposits that are worked there. Kramat Pulai is situated on the contact zone between the huge plutonic mass and the limestone into which it is intruded. The limestone was converted to marble by the intense folding and thermal action that accompanied the intrusion, and an interstratified bed of shale and silt was metamorphosed to pyroxene-schist and biotite-schist. Gently pitching anticlinal structures were imposed upon the metamorphosed rocks, and minor faults at right angles to them were occupied by aplite dykes. Re-opening of the fissures brought in pegmatitic material, permitted solutions rich in tungsten fluoride to have access to the limestone below the schist-bed, forming crystalline intergrowth of scheelite and fluorite. All the scheelite-fluorite ore is of identically course texture, whether it occurs in a large mass more than 100 feet across, or in a thin vein, 1 inch thick, of secondary origin. The temperature of formation of such thin veins must have been low.

CAPE TOWN

Royal Society of South Africa, Sept. 22.—**J. Groves and E. L. Stephens**: New and noteworthy South African Charophyta (2). Descriptions and figures are given of nine new species, also figures of *N. plumosa* and *C. stachymorpha*, and a revision of the species which Braun included under *C. Kraussi* and *C. phæochiton*.—**E. D. Loseby**: Repeated conjugation in *Closterium pritchardianum*, Arch. Conjugation, following immediately on a period of rapid cell-division, occurred three times within a period of two months in a culture of this species. Each period of active reproduction lasted for about ten days, and there was a fortnight of quiescence between. During the period of quiescence the species was represented by undersized cells, and recurrences of active reproduction occurred when they had reached mature size. —**M. R. Levyns**: A revision of *Lobostemon*, Lehm., and a discussion on the species problem In the revision of *Lobostemon* it has been necessary to separate a small section as a new genus *Echiostachys*. *Lobostemon* is divided into five natural groups characterised by well-marked floral characters. Vegetative characters are very variable. Twenty-eight species of *Lobostemon* and three species of *Echiostachys* are described.—**A. Zoond**: The mechanism of projection of the chameleon's tongue. Experiments are described dealing with the muscles of the tongue and the hyoid apparatus, and with the lingual nerves, arteries and veins.—**H. A. Shapiro and L. P. Bosman**: Note on the skin-secreting mechanism of *Xenopus lævis*. The findings of Hogben, Charles and Slome that removal of both lobes of the pituitary in *Xenopus* leads to a cessation of skin secretion in response to mechanical stimulation, are confirmed. This phenomenon as a result of anterior lobe removal takes longer to occur. That the mechanism involved in the skin-secreting response is vaso-motor is unlikely, in view of the fact that injections of histamine have no effect on the secreting reaction, while adrenaline produces a copious viscid secretion.—**I. Schrire and H. Zwarenstein**: Protein metabolism and the effect of injection of pituitary extracts on normal and castrated animals. Both anterior and posterior lobe extracts decrease the high creatinine excretion in castrated male rabbits almost to pre-castration levels. The effect on the normal rabbits is very slight.—**W. J. Copenhagen**: Sulphur as a factor in the corrosion of iron and steel structures in the sea. Observations on the film potential of twenty-one iron and steel structures gave a constant value of $-0 \cdot 3770$ volts (standard error $\pm 0 \cdot 0028$). The presence of a primary and a secondary film on sea-water corroded iron and the significance of sulphur in the primary film are discussed, together with the occurrence of sulphur in corroded zinc plates on ships' bottoms and the possibility that the constant film potential is an iron sulphide—carbon dioxide reaction.

ROME

Royal National Academy of the Lincei: Communications received during the vacation.—**G. A. Blanc**: Persistence of anisotropic structure in silica obtained by the action of acids on leucite. When a crystal of leucite is treated with a strong mineral acid until all the potash and alumina are removed, and is afterwards washed with water and allowed to dry in the air, it exhibits not only the original external crystalline form—which might indicate mere pseudomorphism—but also the internal crystalline structure characteristic of the complex $KAlSi_2O_6$.—**Vladimiro Bernstein**: Theorems relating to the singular points of Dirichlet's series.—**Maria Cibrario**: Preliminary studies on the linear equations to the partial derivatives of the second order of mixed hyperbolic-parabolic type.—**A. Del Chiaro**: The smoothing procedure of Schwarz.—**M. Haimovici and E. Popa**: Correspondence for parallel tangent planes.—**B. Hostinský**: Integration of linear functional transformations.—**L. Laboccetta**: The effective integration of discontinuous functions (1): Summation of punctiform functions.—**L. Allegretti**: The structure of the line 6708 of lithium observed in emission. In agreement with previous results, the distance between the two principal components of this line is found to be $0 \cdot 155$ A. and that between the satellite or less intense component and the component of greater wave-length, $0 \cdot 149$ A.—**L. Pincherle**: A perturbed series of the spectrum of ionised aluminium. Confirmation is obtained of the interpretation recently given by Shenstone and Russell of certain irregular series in line spectra which diverge somewhat from Ritz's form.—**I. Ranzi**: New arrangement for investigating the structure of the Heaviside region.—**G. A. Barbieri**:

Electrolytic preparation of certain complex salts of divalent silver. The preparation of various dipyridyl-argentic compounds from the persulphate is described.—**R. Bigazzi**: A structural constant relating to changes of state. If T is the absolute temperature at which any change of state of a compound occurs, P the molecular weight, and p the specific gravity at 15/4°, it is found empirically that the formula $TP/p^2 = \text{constant} = K$ or, since the molecular volume $V = P/p$, $TV/p = K$ is valid for compounds of similar chemical structure. This expression has an advantage over the parachor, in that it contains only magnitudes which are either known or readily determinable. By the introduction of a factor of complexity c, which represents the greatest width of the graphic formula for any compound, the expression $TP/p^2c = K'$, which gives an approximate constant for the change of state of all molecules of different structures, is obtained.—**F. Garelli and G. Racciu**: Triphenyl phosphate as a cryoscopic solvent. Cryoscopic measurements show that, at 50°, sulphur dissolved in triphenyl phosphate has a molecular magnitude corresponding with the formula S_{10}. In the same solvent, iodine exists as I_2, trimethylenetrinitrotetramine as the trimeride $(CH_2N.NO_2)_3$, and indigo as the simple molecule $C_{16}H_{10}O_2N_2$.—**V. Famiani and V. Zagami**: Comparison between the reconstructive food values of certain vegetables and grain. After fasting, pigeons gain in weight more rapidly on a diet based on *Ervum lens*, *Lathyrus sativus* or *Lathyrus cicera* than on one based on *Triticum vulgare*. Moreover, the recovery of a given percentage loss of weight requires appreciably less of the former than of the latter diet.—**C. Andreatta**: New investigations on bianchite: synthetic bianchite. Crystallisation of a solution containing zinc and ferrous sulphates and sulphuric acid yields an isomorphous mixture of composition approximating to that of natural bianchite, for which the formula $(Zn, Fe)SO_4, 6H_2O$, with the ratio $ZnO : FeO$ very nearly 2 : 1, is established.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 18, 567–608, Sept. 15, 1932).—**Alan W. C. Menzies**: The vapour pressure of liquid water that has recently been frozen. T. C. Barnes has reported that water containing large quantities of trihydrol (associated water molecules) promotes the growth of algæ. If recently frozen water contains more such associated molecules than recently condensed water, it might be expected to show a different vapour pressure. Experiments at 25° and 3° with a glass differential pressure apparatus showed no such difference.—**Henry B. Ward**: The origin of the landlocked habit in salmon. Such races of salmon are known from many rivers of North America and elsewhere, often where there is no barrier preventing the fish from migrating to the sea after hatching in the upper waters. They are generally smaller than the sea-run species from which they probably originated. It is suggested that the chief factor in the production of such dwarf races is temperature of the surface water, rather than a stream barricade or food abundance. For example, a power dam creates a lake with little current, the surface waters of which quickly attain a temperature too high for the young fish; the fish descend to the cooler layers and, finding no outlet, remain there. Glacier action and earth movements in the past may have had similar effects, leading to the appearance of landlocked fish in streams which now have no barriers.—**N. A. Wells**: The importance of the time element in the determination of the respiratory metabolism of fishes. Fish were transferred to a constant flow apparatus and their oxygen consumption measured. For the species used, *Fundulus parvipinnis*, of average weight 6 gm. at a temperature of 13° C., the average value over a period of eight hours after a lapse of twenty-four hours or more in the respiratory chamber represents the normal metabolism. High values are obtained while the fish are settling down in their new environment and any disturbance immediately increases the metabolic rate. The temperature of the environment before entering the respiratory apparatus has little effect on the general trend of the metabolism.—**Otto Struve**: Thermal Doppler effect and turbulence in stellar spectra of early class. The lines of these spectra have cores of the width required by the theory of Doppler broadening. The fuzzy lines in the spectra of A, B and O stars are probably due to 'rotational' broadening rather than to turbulence.—**O. Struve and W. W. Morgan**: On the intensities of stellar absorption lines. A brief report of work in progress at Yerkes Observatory. It is known that the relative intensities of the singlet and triplet lines of helium are not the same in all stars; there are similar differences in the doublets and quartets of singly ionised oxygen and even in the multiplets of other elements. No explanation is offered.—**H. S. Vandiver**: Note on the divisors of the numerators of Bernoulli's numbers.—**G. A. Miller**: Non-group operations.—**Arnold E. Ross**: On representation of integers by quadratic forms.

Forthcoming Events

MONDAY, DEC. 19

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—H.R.H. Prince Sixte of Bourbon: "Great Routes of the Sahara, Past and Future".

Official Publications Received

GREAT BRITAIN AND IRELAND

Institute for Research in Agricultural Engineering: University of Oxford. Increased Production in Agriculture: Papers read at the Meeting of the British Association for the Advancement of Science at York, 1932. By Dr. H. J. Denham, S. J. Wright, A. J. Hosier and D. R. Bomford; with a Commentary by C. S. Orwin. Pp. 35. (Oxford.) 1*s*.

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 2, No. 13: The Genera *Dictyoconoides* Nuttall, *Lockhartia* nov., and *Rotalia* Lamarck; their Type Species, Generic Differences and Fundamental Distinction from the *Dictyoconus* Group of Forms. By Lieut.-Col. L. M. Davies. Pp. 397–428 + 4 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 5*s*. 6*d*.

Journal of the Chemical Society. November. Pp. iv + 2665–2812 + viii. (London: Chemical Society.)

The University of Manchester: The Manchester Museum. Report for the Year 1931–32. Pp. 23. (Manchester.) 6*d*. net.

OTHER COUNTRIES

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 26, 1930, No. 3. Pp. clxxxv. (Calcutta.) 4.8 rupees.

Anales del Museo Nacional de Historia Natural Bernardino Rivadavia, Buenos Aires. Tomo 35. Pp. xi + 341 + 35 plates. (Buenos Aires.)

Sudan Notes and Records. Vol. 15, 1932. Part 1. Pp. iv + 157 + 23 plates. 30 P.T.; 6*s*. Part 2. Pp. iv + 159–280 + 16 plates. 30 P.T.; 6*s*. (Khartoum: Sudan Notes and Records.)

Japanese Journal of Physics. Transactions and Abstracts, Vol. 8, No. 1, September 18. Pp. iii + 56 + 20. (Tokyo: National Research Council of Japan.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 21, No. 3, October. Pp. 299–454. (Tokyo and Sendai: Maruzen Co., Ltd.)

U.S. Department of the Interior: Geological Survey. Bulletin 831–B: The Ashland Coal Field, Rosebud, Powder River and Custer Counties, Montana. By N. W. Bass. (Contributions to Economic Geology, 1931–32, Part 2.) Pp. v + 19–105 + plates 3–27. Bulletin 835: Geology and Oil Resources of the Elk Hills, California, including Naval Petroleum Reserve No. 1. By W. P. Woodring, P. V. Roundy and H. R. Farnsworth. Pp. v + 82 + 22 plates. 60 cents. Bulletin 836–E: The Tatonduk-Nation District, Alaska. By J. B. Mertie, Jr. (Mineral Resources of Alaska, 1930.) Pp. ii + 347–443 + plate 7. 15 cents. (Washington, D.C.: Government Printing Office.)

SATURDAY, DECEMBER 24, 1932

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Technical Education and Progressive Industry*

As a result of a recent visit to France, Belgium, Czechoslovakia and Holland to investigate technical education at the apprenticeship stage and trade schools in particular, two Board of Education inspectors, Messrs. A. Abbott and J. E. Dalton, have produced a valuable report on the relation of technical education to industry in Great Britain. Their conclusions derive greater weight from the moderation of the report.

The report shows clearly that while Continental countries direct their main effort towards giving a severely practical training to recruits before they enter industry, their full-time pre-employment schools being in effect a part of the industrial rather than of the educational system, in Great Britain the whole system of technical education has been built up on the basis of the part-time instruction of young persons *after* they have entered industry. While, for example, we regard the technical school mainly as a place where instruction in the principles underlying industrial practice should be given and have usually left training in workshop methods to the mill or works itself, in France the technical school is looked upon as an institution which combines a good deal of instruction in workshop methods with instruction in the principles underlying this practice. The junior technical school, in fact, remains part of the educational system of Great Britain and is not part of the industrial system; and there is a definite difference in the way in which the burden of training recruits to industry is shared between the community and the employer in Great Britain and on the Continent.

The causes of this divergence are partly to be found no doubt in the greater interest taken in technical education in the countries visited than in Great Britain and particularly in the profound conviction that technical education is a most powerful instrument for maintaining and increasing industrial efficiency. The Belgian Ministry, for example, regards technical education as not merely an attempt to train well-disposed and ambitious individuals to occupy higher posts, but rather a definite effort at training an industrial army, officers and rank and file alike, which by its morale and technique will safeguard and strengthen the economic life of the State.

This view of technical education as organised

* Board of Education. Educational Pamphlets, No. 91 (Industry Series, No. 11): Trade Schools on the Continent. Pp. 110. (London: H.M. Stationery Office, 1932.) 2s. net.

to serve the needs of industry and the State is one to which the report rightly directs our attention and should assist in provoking that much needed public interest in the problems of technical education, from the lack of which it has suffered considerably. The individualistic view of education requires to be replaced by a wide vision of service for industry and the State if either public interest is to be roused or adequate co-operation secured between neighbouring local education authorities and between educational authorities and industry. Apart from the fact that certain of the weaknesses in our institutions for technical education are due to their having been built up too much in response to a demand from below and not enough in response to requirements from above, the only secure basis for developments of technical education in Great Britain is a keener and more widely diffused appreciation of the benefits to be derived from it.

The present report is essentially a further plea for the definite planning of technical education in relation to the needs of industry and society as a whole, rather than in response to individual requirements or ambitions. Technical education is so significant a factor in industrial efficiency that the public interest demands that our system of training craftsmen should be kept abreast of the times. Although up to recent years, when the emphasis was on the personal factor, industry and commerce were able to rely on evening classes for the bulk of our technical education, this form of instruction cannot remain permanently as the chief provision of technical instruction in a modern industrial State. It should be replaced to a considerable extent by a system which involves less strain on the student and yields fuller results. The tradition in Great Britain of evening education should, in the interests alike of the students, of industry, and of the community, play a much smaller part than at present in our educational system.

The justice of this argument is difficult to deny. So far as the cost of extending the volume of technical education for part-time day students is concerned, a considerable amount of accommodation in technical schools is at present vacant during the day and the increased cost would be mainly in payment of instructors. Apart from this, the present unemployment situation and the general problem of leisure with which we are confronted suggest that part-time day instruction is a rational method of completing any deficiencies in the education which the recruit to industry has previously received, and one thoroughly justified on economic grounds even in times of financial stringency.

While placing its main emphasis on the extension of part-time post-employment instruction and particularly its transfer from the evening to the day, the report also advocates a steady but discriminating increase in the number of junior technical schools to meet the needs of a particular type of pupil and of special industries or grades of occupation, as well as an increase in the number of junior vocational schools which are definitely trade schools. It is considered that it would be a mistake to replace the junior technical school as it exists in England by any form of pre-employment training seen on the Continent.

There is, however, a further fundamental problem which is also involved in any deliberate re-planning of technical education in relation to industry and commerce, and to this also the report directs attention. Even educational enthusiasts have often failed to realise that the development of the educational system is a social and economic phenomenon of profound significance, and accordingly the check to the vertical mobility of labour which is becoming apparent under the new conditions of industry and education has yet to receive full examination. Industry itself, for example, has not fully realised the bearing upon industrial recruitment and promotion, of the educational changes which now provide it with two separate streams of recruits differing considerably in quality according to their selection or not at the age of eleven years for admission to schools with a leaving age higher than fourteen years. The number of the selected group inevitably will, as a whole, outstrip those of the unselected group in competition for the more responsible and attractive posts in industry, and the responsible officers of industry will thus come from a group of individuals picked out at an early age for prolonged education.

The question of the educational provision to be made for the rank and file of industry demands increasingly the most serious consideration. Very few of them can hope for much promotion and only very exceptional boys of great ability and determination can look forward to securing posts higher than that of foremen. In addition, technical education, which until quite recently has been mainly post-elementary in character, has to adapt itself to meet more efficiently the needs of the

growing numbers of students who have received a prolonged general education. Both facts—the entrance to industry of considerable numbers of youths with a prolonged general education and the diminished incentive which ambition can provide—may, however, decrease the attendance of the next generation at vocational evening classes. It is probable that, as has been suggested by Lord Eustace Percy, the technical part of such education will best be arranged in part-time day classes while evening classes are reserved for more general instruction involving something in the nature of change and relaxation, and that evening study in particular should be organised on lines calculated to preserve or restore the adaptability of the British workman, the loss of which is under modern conditions as serious for the worker as it is to industry itself. It is only as we are bold enough to make our schools the creators of new social standards, instead of the slaves of existing ones, and to demand a development of those parts of our educational system which can admit men and women to the coveted social status which at present belongs to the professions and the middle and higher walks of commerce, that we can expect to disperse much of the prevailing dissatisfaction and unsettlement in our industrial society. The rigidity of both the skilled or semi-skilled worker, and their reluctance to undertake any other kind of occupation, are due alike to the scarcity of industrial standards entitling the worker to such respect and the fear of losing any scanty rating once acquired with a particular occupation.

Messrs. Abbott and Dalton, in the report before us, have produced a valuable document which enables the whole field of technical education to be surveyed in relation to modern industrial requirements. In addition to their emphasis on technical education as a factor in commercial and industrial efficiency and their discussion of the respective contributions of part-time instruction, the technical school and the senior elementary school, they direct attention to such important aspects of the problem as the training of teachers and the effect of vocational guidance. The whole situation calls for the closest and most careful study and co-operation by industry and by educational authorities. Industrial efficiency and the widest national interests will only be served by wide views and a deliberate policy conceived not in relation to immediate financial contingencies but in regard to the 'long range' requirements of our industrial society. In the present position, this can only be secured as the industrial and commercial professions consciously and actively contribute a liberalising influence to the standards of education like that exerted by the 'liberal' professions in previous centuries, and assist in a firm resistance to any reactionary or short-sighted policy which may jeopardise the future efficiency of industry or the welfare of society. Scientific workers engaged in industry no less than in teaching have a decisive part to play in the formulation of a practical policy of technical education and of a liberal and constructive philosophy capable of taking the wide views so essential if the educational system is to serve its primary purpose of fitting the coming generation to take its place in the life of a scientific age, in which vocational demands are ever increasing.

Max Planck's Theoretical Physics

(1) *Theory of Electricity and Magnetism.* Pp. xii + 247. 10*s.* 6*d.* net. (2) *Theory of Light.* Pp. vii + 216. 10*s.* 6*d.* net. (3) *Theory of Heat.* Pp. viii + 301. 12*s.* net. Being Vols. 3, 4 and 5 of *Introduction to Theoretical Physics.* By Prof. Max Planck. Translated by Prof. Henry L. Brose. (London: Macmillan and Co., Ltd., 1932.)

QUANTUM theory originated in the work of Prof. Max Planck of Berlin in the year 1900. It is significant that the new theory arose out of a discrepancy between theory and experiment in a somewhat recondite field of investigation, described by Lord Kelvin as one of the clouds over nineteenth century physics. The subject of research was the character of the heat radiated from a hot body—at first glance not a very promising field for anyone looking out for startling discoveries. But when we reflect that this 'radiation problem' involves the whole question of radiation and its relations to tangible matter, its importance becomes evident. Planck's paper "On the Distribution of Energy in the Normal Spectrum" was read before the German Physical Society on December 14, 1900. He had already announced his radiation formula, and in this paper he described a method of deducing it from the hypothesis that the rectilinear oscillator (dipole) of Hertz, regarded as a source of radiation, can possess energy only in integral multiples of the quantum $h\nu$. The universal constant, h, of

the radiation law, being the product of energy and time, was called the elementary quantum of action.

Planck himself has always adopted a cautious and conservative attitude towards the new theory, and time and again strove to bring about agreement with the principles of classical dynamics. "Since nothing probably is a greater drawback to the successful development of a new hypothesis than overstepping its boundaries, I have always stood for making as close a connection between the hypothesis of quanta and the classical dynamics as possible, and for not stepping outside of the boundaries of the latter until the experimental facts leave no other course open."

One of the pressing problems for the teacher of physics at the present time is to know how to deal with the ever increasing mass of new material without sacrificing what is essential of the old. For this reason it is a matter of moment that a brilliant and original theorist should have found time to place on record a statement of what he considers of fundamental importance to the student of physics, and we are grateful to Prof. Planck for his successful labours. His earlier works on thermodynamics and heat radiation had led us to expect a well-balanced and lucid account of modern theoretical physics, and in the three volumes now before us we are not disappointed. Volumes on general mechanics and the mechanics of deformable bodies form the first two of the series of five works comprised in Prof. Planck's "Introduction to Theoretical Physics". The translation into English is in the competent hands of Prof. Henry L. Brose.

(1) The volume on electricity and magnetism is essentially deductive in its method. Two fundamental ideas are employed in the development of the subject—the Principle of Conservation of Energy, which is given priority, and the Principle of Contiguous Action. This second principle, which postulates action by contact as opposed to action at a distance, is the basis of Maxwell's theory. "Everything which happens at a certain place at a certain time is completely and uniquely defined by the events which have occurred immediately preceding it in the immediate neighbourhood of the place." It is claimed that this theory owes its sovereign position over all others to its greater definiteness and simplicity. The book accordingly starts in somewhat unusual fashion by giving expressions for the energy of the electromagnetic field, followed by Poynting's vector for the flux of electromagnetic energy. This procedure is of special interest in view of the criticism which Poynting's theorem has received in recent years. From these principles Maxwell's fundamental equations for the electromagnetic field are derived. The electrostatic field and the magnetostatic field are then discussed, together with molecular and ponderomotive actions in the stationary field. Finally, quasi-stationary and dynamical processes are considered and also the limits of the electrodynamics of Maxwell and Hertz. This all too brief summary will serve merely to give some idea of the scope of the work, which deserves the careful attention of the advanced student. The treatment of the different systems of units and the dimensions of electric and magnetic quantities deserves special commendation.

(2) In the first three volumes of the series matter is assumed to have absolutely continuous properties, but in the volume on light the atomic point of view must be adopted. This is necessary in dealing with dispersion, for the interaction between light waves and vibrating particles must then be considered. Some of the more daring speculations in quantum theory were due to Einstein, who in 1905 put forward the hypothesis of 'light quanta', and later applied quantum ideas to account for the thermal capacity of a solid at low temperatures. In the present volume the opportunity is seized of showing how optical theory links up with quantum mechanics. The analogy between classical mechanics and geometrical optics is described, and it is shown how L. de Broglie based on this analogy an explanation of quantum phenomena. Schrödinger afterwards developed the idea further and embodied Hamiltonian and optical principles in his wave equation.

(3) The last volume deals with heat because the theory occupies a special position as compared with other physical theories. The First Law of Thermodynamics is merely a particular case of the Principle of the Conservation of Energy, but the Second Law introduces a new conception which is peculiar to heat. As soon as heat enters into the question, the sequence of events tends to approach a definite end in which a state of thermal equilibrium is established. "Hence all occurrences in which heat plays a part are in a certain sense unidirectional, in contrast with mechanical and electromagnetic events, which can equally well take place in the reverse direction, since for them the sign of the time factor is of no consequence." Perhaps some caution is advis-

able before dogmatising on this difficult question, in view of the limited nature of human experience. In the first two parts of the book the author deals with heat in bodies, and afterwards also with radiant heat. The third part is concerned with the classical laws of radiation and the last part contains a valuable account of Planck's own work on the theory of quanta as applied to the energy distribution in the normal spectrum, and the equation of state of material bodies.

These volumes should take their place in the library of every physicist. H. S. ALLEN.

Antarctica

The Conquest of the South Pole: Antarctic Exploration 1906–1931. By J. Gordon Hayes. Pp. 318 + 24 plates. (London: Thornton Butterworth, Ltd., 1932.) 18*s*. net.

DR. H. R. MILL'S "Siege of the South Pole" was published in 1905. It was a scholarly book, full of the author's enthusiasm for the explorers and their work, and with just sufficient of the popular to recommend it to the general as well as to the informed reader. Many regard it as the best book on the Antarctic, and it is certainly among the first half-dozen, occupying an honoured place with the travel narratives themselves; with Scott's "Voyage of the Discovery", Shackleton's "Heart of the Antarctic", and Shackleton's "South".

Dr. Mill's book ended with the period of the British Antarctic Expedition, led by Capt. Scott in the *Discovery* in 1901–4. Fresh expeditions from that date have followed one another in rapid succession, and in 1911, for example, there were as many as seven separate parties in the field belonging to five expeditions. As Dr. Mill says in his introduction to Mr. Hayes' book, he was soon bombarded by demands for a continuation; and he made up his mind to rewrite and modernise the "Siege". Other factors however intervened, and perhaps providentially. It is doubtful if a sequel or a revision can ever repeat a first success. Dr. Mill in the end had to give up the idea either of rewriting the "Siege" or publishing a fresh book to deal with the last twenty-five years. Concurrently, however, he had found Mr. Gordon Hayes more than willing to undertake the work and anxious also to be guided by his predecessor. The present book is the result, written by Hayes and approved by Mill.

The expeditions dealt with begin with Shackleton's journey to the plateau in 1909, when he outdistanced his predecessors by more than 400 statute miles. Hayes, like Mill, is carried away with enthusiasm. Charcot, Amundsen, Mawson and Scott take their place among his heroes; and if Amundsen, the conqueror of the South Pole, gets less space than the others, it is a tribute probably to the speed of his dash south and to the efficiency of his plans. In the author's opinion the heroic age ends with the adventures of the *Endurance*, when the ship was lost, but Shackleton brought his party back intact.

For the later expeditions, Mr. Hayes prefers the adjective mechanic rather than homeric, but not to the exclusion of heroism. Wilkins, Riiser-Larsen, and Byrd are all flying men, and they have all of them shown how discoveries are now dominated by the machine. There is a limit, however, to the effectiveness of the aeroplane, as exploration, in its widest sense as distinct from discovery, must still be done on the ground. This is driven home both by Hayes and by Mill; the aeroplane may be the eyes of the Antarctic leader; to explore and to conquer is still the work of the man on the ground. The motor sledge will be his ultimate standby; but meantime dogs and men may still make records in the Antarctic. J. M. WORDIE.

Structure of Crystals

The Structure of Crystals. By Ralph W. G. Wyckoff. (American Chemical Society Monograph Series, No. 19.) Second edition. Pp. 497. (New York: The Chemical Catalog Co., Inc., 1931.) 7·50 dollars.

DR. WYCKOFF'S monograph on "The Structure of Crystals" has, in the second edition, been revised so drastically that it is in effect a new book, since, although the experience gained from the first edition has not been lost and many of the figures have been retained, the original text has been sacrificed almost in its entirety. A most praiseworthy sequel is that the main text is actually shorter by 27 pages, but the bibliography, which began with 7 entries for 1912 and included 112 entries for the year 1922, has now expanded to 367 entries for 1930 and occupies altogether nearly eighty pages in the new edition.

The principal additions include an introductory chapter, which makes it easier to start reading the book, and new sections on the production of X-rays, the scattering power of atoms, atomic

sizes and co-ordination. The experimental chapters in Part I, "Methods of Crystal Analysis", have also been arranged in a different order. In Part II, "Results of Crystal Analysis", the old chapters dealing with oxides, chlorides, nitrates, etc., have also been displaced by chapters dealing with the types RX, RX_2, R_2X_3, RX_3, $R_x(MX_3)_y$, $R_x(MX_4)_y$, etc. These are preceded by a chapter on "Elements and Alloys", in which all the data available up to 1930 are summarised, and are followed by chapters on hydrates and ammoniates, silicates and organic compounds, all provided with similar tables and references to the bibliography.

The only fault which the reviewer has discovered is that in the new edition references are given exclusively to these tables, so that it is no longer possible from the index to trace the pages on which such familiar structures as those of rock salt and fluorspar are illustrated. On the other hand, the author has accomplished the unwonted exploit of writing a second edition of which the text is shorter and not less readable than that of the first, in spite of the enormous mass of additional knowledge with which he has had to deal. The new edition is therefore even more useful in 1932 than its predecessor was in 1924, and is likely to be in still larger demand.

Harvey's Successor

Early Science in Oxford. By R. T. Gunther. Vol. 9: *De Corde. By Richard Lower, London, 1669.* With Introduction and Translation by K. J. Franklin. Pp. xxxv + 374 + 8 plates. (Oxford: R. T. Gunther, 5 Folly Bridge, 1932.) 21*s*.

THOSE who follow the trend of human anatomy in England may have noted the appearance of certain additions which Dr. Franklin, of Oriel College, Oxford, has made to our knowledge of the venous system. It is uncommon in these days to find an anatomist or physiologist who, before setting down the contribution he is to make to modern knowledge, takes pains to discover not only what his immediate predecessors know but also what his remote predecessors have discovered, in the particular field of inquiry he has undertaken.

Dr. Franklin has the happy gift of compelling the past to help in unravelling the problems of the present. By rendering into English Richard Lower's "Tractatus de Corde" he has given its author a high and distinguished place amongst anatomists and at the same time has rendered a service to modern anatomy, for beyond doubt, the utility of Richard Lower's investigations is far from exhausted.

Harvey's discoveries were published in 1629; Lower was born in 1631; his tract on the heart was published in 1669, twelve years after Harvey's death. A close study of Dr. Franklin's translation leaves no doubt as to Lower's position; he was, after Harvey, the greatest anatomist produced in England during the seventeenth century. He came against medical men who still doubted the truth of the functional explanation which Harvey had given of the heart and of the blood vessels of the body. Following in Harvey's footsteps, he again submitted the heart to anatomical analysis and experimental proofs and discovered many truths, supplementary to those of Harvey, which have been rediscovered in quite modern times. Even to-day, physiologists have something to learn from him regarding the manner in which the heart is fixed, so that it can serve as a pump; his description of the intricate arrangement of the musculature of the heart and his conception of the manner in which the blood is expelled from the heart by its musculature—"like the wringing of a linen cloth to squeeze out water", come nearer the truth than are to be found in modern textbooks.

In all his investigations, Lower was guided by the assurance that the clue to function was structure, but he also knew that final proof had to be sought in experiment. In the course of his experiments he produced conclusive evidence that it was the absorption of air in the lungs which gave blood its arterial colour.

Lower, it must be admitted, made many mistakes in his attempts to explain the structure of the human body, and his name has come down to modern times attached to one of these. Dr. Franklin reproduces not only a facsimile of the original text of "De Corde" but also of its illustrations. Fig. 1 is a drawing of a heart—which is said to be human. The superior and inferior venæ cavæ are made to enter the right auricle at an angle and so close together that their adjacent margins form a projection or swelling. This projection was described by Lower and has been named the "tubercle of Lower". One may well suspect that the heart figured by Lower was not human, for it shows a prominent caval angle which is characteristic of the heart of quadrupeds and not, as he asserted, of the human heart.

Lower deserved a better fate than to have his name handed down to posterity linked to one of his mistakes. Fig. 1 of Plate V gives a view of the interior of the human left ventricle in which is rendered a most faithful representation of the conducting system of the heart, the true nature of which was discovered by Tawara only twenty-five years ago.

Lower was one of the brilliant band of scientific men who made their home in the University of Oxford during the Commonwealth and founded the Royal Society after the Restoration. Robert Hooke and he were members of Christ Church, and it is right that Dr. R. T. Gunther should have devoted the ninth volume of "Early Science in Oxford" to the work of Lower, since the eighth was given to that of Hooke.

Short Reviews

(1) *How to be Happy though Human.* By Dr. W. Béran Wolfe. Pp. xiv + 374. (London: George Routledge and Sons, Ltd., 1932.) 10*s.* 6*d.* net.

(2) *Discovering Ourselves: a View of the Human Mind and how it Works.* By Dr. Edward A. Strecker and Dr. Kenneth E. Appel. Pp. xiii + 306. (London: Chapman and Hall, Ltd., 1932.) 15*s.* net.

(3) *Effective Thinking.* By Joseph Jastrow. Pp. xiv + 263. (London: Noel Douglas, 1932.) 7*s.* 6*d.* net.

(4) *The Sex Education of Children: a Book for Parents.* By Mary Ware Dennett. Pp. viii + 142 + 4 plates. (London: George Routledge and Sons, Ltd., 1932.) 3*s.* 6*d.* net.

WE notice these four books together because they all bear upon a common theme—the art of living. They all exemplify the fact that medical men and psychologists are partly taking the place formerly occupied exclusively by moralists, in teaching that art. "Mental hygiene," says Dr. Wolfe, "is the science of the hour. In its twenty-five years of existence this infant among the sciences has already contributed a distinctive flavour to the twentieth century." To like effect Drs. Strecker and Appel write—"There seems to be a general need for a more intelligent understanding of mental hygiene." Both these books take the view that, the value of physical hygiene being now everywhere accepted, mental hygiene must have its turn. Dr. Wolfe owns Alfred Adler as his leader. But he stands firmly on his own feet, basing his treatment of the subject largely upon cases from his private and clinical practice. He has written an excellent book, which deserves lengthier notice than it can receive here. The same may be said of "Discovering Ourselves". The authors of this book help the general reader by the use of illustrative diagrams, quite effective in their way. They write sanely and sensibly, and so clearly that no educated reader can miss their meaning. One can say so much, without committing oneself to all their views.

In the third book on our list, we pass from mental to 'logical hygiene'. The author makes it clear that 'effective thinking' does not come entirely by the light of Nature. But instead of the logic of the textbooks, he gives an analysis, popular but not shallow, of the technique of thinking, and of the impediments in the way of accurate thought. He makes us wish that our politicians and journalists and other modern guides could be compelled to make a careful study of his book.

In the fourth book we pass to the much discussed subject of sexual hygiene, certainly a most important factor in the art of living. Limitations of space forbid us to say more than that it is one of the best books of its kind we have seen. It is sane, sound, and admirably written.

A Short History of Atomism: from Democritus to Bohr. By Joshua C. Gregory. Pp. vi + 258. (London: A. and C. Black, Ltd., 1931.) 10*s.* 6*d.* net.

IT is the epic of the successive dynasties of the atom that Mr. Gregory sets himself to recount in his very interesting book. From Democritus, who was the first to discuss atoms, down to the present day, we are given a panoramic but accurate description of the various types of atoms which have held the field of science and speculative philosophy; and though a bibliography would have been helpful, the absence of notes is more than compensated by the specialised knowledge that Mr. Gregory has of this very difficult subject.

It is, of course, the modern period which is considered at great length by the author. We are shown, for example, how Daltonian atomism, striking into thought about midway between the conceptions of Boscovich and Faraday, formed the background of the remarkable labours of Gay-Lussac, Avogadro, Faraday, Prout, Thomson, Rutherford, Helmholtz, Goldstein, Röntgen, Kelvin, Curie and others. But though this revival of the Democritean and Newtonian atom held its own until the end of the nineteenth century, it had finally to give way to the electrical structure of matter, a conception which was steadily invading science when Thomson accepted Kaufmann's hypothesis that the mass of β-particles was entirely electromagnetic. Democritus and Epicurus would have been surprised at the complicated types of atoms that have been constructed since; though they would feel more at home with the spontaneous swerves which, without any apparent cause, hurry the atoms into their disintegrating course. Heisenberg's principle of indeterminacy, coupled with the developments of wave and quantum mechanics, will no doubt lead

us into new conceptions about the atoms. Besides their scientific and perhaps practical interest, the question arises whether the new atomic theories, now in their period of gestation, will lead us away from instead of into reality. T. G.

Laboratory Manual of Organic Chemistry. By Dr. Harry L. Fisher. Third edition, revised. Pp. xvii + 368. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 13*s*. 6*d*. net.

ADDITIONS in the third edition of this manual include general notes, sixty-eight experiments and a large section devoted to methods of quantitative organic analysis. The style is clear and the subject matter has been brought up to date. The book differs from most of the other practical organic chemistry books in that, instead of describing a large number of preparations from which some can be selected for the student to perform, all the experiments described can be and are intended to be completed by the student during his course, and on completion he should have practical experience of all the processes described in the book.

The experiments, to each of which a series of questions is appended, appear to have been chosen to give the student a wide experience of the manipulation of the various types of apparatus used in organic preparation. The manufacture by young students of such materials as dry metallic acetylides and molecular sodium is, however, not without risk.

The chief merit of the book is the inclusion of a surprisingly large number of those little tips which make the difference between the technique of the student and the capable research worker and which are usually left to be learnt from personal experience and one's fellow workers. The book is well worth the attention of those responsible for laboratory courses. L. C. N.

Müller-Pouillets Lehrbuch der Physik. Elfte Auflage. Herausgegeben von A. Eucken, O. Lummer, E. Waetzmann. In 5 Bänden. Band 4: *Elektrizität und Magnetismus.* (1) Teil 1: *Grundlagen der Lehre von der Elektrizität und dem Magnetismus.* Bearbeitet von Siegfried Valentiner. Pp. xxi + 734. 47.50 gold marks. (2) Teil 2: *Technische Anwendungen der Elektrizitätslehre* (*Elektrische Maschinen, Kraftübertragung, Telegraphie*). Bearbeitet von H. Decker, E. Flegler und G. Möller. Herausgegeben von Siegfried Valentiner. Pp. xvi+462. 30 gold marks. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1932.)

"MÜLLER-POUILLET" needs no bush. The fourth volume of this standard treatise is divided into two parts, dealing with the fundamentals of the 'classical' part of electricity and magnetism, and with certain technical applications respectively. The treatment is full and thorough, while remaining elementary in character, and emphasis is laid on descriptions of measurement and instruments, rather than on developments of a formal mathematical type. The technical applications dealt with are those of most concern to the physicist, and are handled in thoroughly interesting and competent fashion. The volume is well illustrated and documented, and the teacher of physics will find it a most useful addition to his bookshelves. A. F.

Economic Geography of Europe. By Prof. W. O. Blanchard and Prof. S. S. Visher. Pp. ix + 507. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 17*s*. 6*d*. net.

THERE was need of a textbook on the economic geography of Europe that discussed broad issues and was not overburdened with facts and figures. This volume largely fills the gap. It was prepared for American students but that is no disadvantage since it appears to be singularly free from bias and treats the whole of Europe impartially.

The first part of the book treats Europe as a whole, starting from the essentials of physical geography. The second and longer part takes the different countries in turn, and this part is perhaps the most valuable, though apt to be superficial in places. It is written in a readable style and care has been taken not to clog the pages with facts of location or figures of trade, though these are not neglected where necessary.

There are many excellent maps and diagrams and careful bibliographies to each chapter. In an end pocket is a large folded 'physiographic diagram' of Europe which is in the nature of a pictorial map of surface features. This should prove useful even in the absence of a key to the regions.

The Open World: Three Lectures on the Metaphysical Implications of Science. (The Terry Lectures.) By Prof. Dr. Hermann Weyl. Pp. vi + 84. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1932.) 9*s*. net.

THIS book, which makes delightful reading, expresses the conviction that modern mathematics and physics make the world appear more and more as an open one; that is, they point to a world beyond the actual structures by which science describes the bounds of our positive knowledge. Science can do no more, however, than show us this open horizon; we must not by including the transcendental sphere, attempt to establish anew a closed though more comprehensive world. This main thesis is developed in three lectures on God and the universe, causality, and infinity. The profound and provoking opinions put forward by Prof. Weyl are a valuable addition to the testimonies expressed by prominent scientific workers as to the real value of their professional experiments and studies. T. G.

Tropical Plant Diseases: Their Importance and Control*

By Dr. E. J. BUTLER, C.M.G., C.I.E., F.R.S.

IN the great tropical and subtropical plantation industries, such as tea, rubber, coffee, cocoa, citrus fruits, etc., large areas of permanent crops are cultivated on capitalistic lines with uniform and usually white control. On an estate of hundreds or even thousands of acres, often under highly intelligent supervision and where the produce may be worth a great deal of money, it is comparatively easy to get adopted improvements which are the results of scientific research, whether in the control of disease or in any other direction. It is quite a different matter, however, when one comes to deal with the crops grown by the indigenous people of the tropics for their own use. Their agricultural practices are rigidly traditional, their standard of intelligence may be low, money is scarce or even absent, and their crops are raised in small holdings, often subdivided to an almost incredible degree. I once had occasion to acquire 17 acres for expansion of an agricultural research station in India and found 30 families and 91 individual plots represented in this piece of arable land. In such conditions—and they are those under which a great part of the population of the world lives—"the cultivator's ways and the sheep's ways tend to be much the same", as an Indian proverb says, and however well the traditional agricultural methods are followed, the cultivator is apt to be helpless in an emergency as, for example, an outbreak of epidemic plant disease.

It is not surprising that the earlier plant pathologists who worked in the tropics, from the time when Marshall Ward went to Ceylon in 1880 to fight coffee leaf disease when it was already too late to save the industry from ruin, should have concerned themselves mainly with the diseases of the great export crops. A study of the reports of fifteen or twenty years ago will show that for practical purposes, India was the only tropical British possession in which it was the policy of the agricultural departments to devote much of their attention to the crops grown by the people of the country for their own use. During the past ten years, however, there has been a considerable improvement in this respect in the British Colonies, especially those of tropical Africa. Most of the colonies have one, and a few have two, plant pathologists attached to the agricultural departments and where as in several of them there are no plantation crops, the needs of the village cultivators are receiving attention. Even in some of the more advanced 'plantation' colonies such as Ceylon and Malaya, the large plantation industries have now organised their own research departments, leaving the Government departments of agriculture free to concentrate on the improvement of the local crops and methods of farming.

Such improvements are likely to increase the responsibilities of the plant pathologists. New and improved varieties of crop plants are liable to become attacked by diseases from which the old ones had become immune through age-long selection, and more intensive methods of farming often have a similar result. The great activity in crop improvement that has been characteristic of agricultural development in the United States and Canada since the beginning of the present century, has been accompanied by such an increased call on the services of plant pathologists that each of the staple crops has, not one but many, men engaged in the study of the cause and control of the diseases to which it is liable. As similar efforts are made to improve the staple food crops of the tropics similar needs will be felt. There are clear indications from the work on rice in Japan that even in a crop such as this, which in India is one of the healthiest of all the field crops, there is a number of diseases capable of becoming formidable obstacles to the introduction of improved varieties.

The two tropical cereals next in importance as food crops, sorghum and the bulrush millet, are much more subject to disease than rice, but very little work has been done on them in the tropics and even the full life-history of several of the common bulrush millet parasites is unknown. Still less is known of the diseases of the tropical pulses and other plants of economic importance, except those that are grown for export. Tropical plant pathology has not much to boast of in the study and control of village and field crop diseases; the number of man-years of work put into this branch of agricultural science is too small to have yielded much result and the difficulty of getting the native cultivator to change his ways, as well as his lack of means and general backwardness, has helped to induce a pessimistic outlook amongst those who are charged with the control of agricultural research and amongst the research workers themselves. Nevertheless, not only because there is great preventable loss of crops from disease in the tropics but also because a solid knowledge of the pathology of each crop plant is a necessary concomitant of all attempts at crop improvement, means must be found to surmount these difficulties. Little by little, openings for successful attack on them will appear, and however slow progress may be at first, the next fifty years are bound to see a great improvement in the crops and in the general agriculture of even the most primitive of the African Colonies. In this advance plant pathologists will have to bear an ever increasing share.

The work which has been done in India during

* From a semi-popular lecture delivered before Section K (Botany) of the British Association at York on Sept. 2.

the past twenty-five years or so illustrates some of the problems that the tropical pathologist has to face in dealing with village and field crops. When the Indian agricultural department was formed thirty years ago, extremely little was known of the diseases of tropical plants, though there were a few exceptions, such as sugar cane. The first work done in the mycological branch, therefore, was to make a survey of the diseases of the more important crops, and when many of these were found to be undescribed, a more intensive study of a few was undertaken and lasted a number of years. Two of them, one on palmyra and coconut palms and the other on rice, broke out in epidemic form and had to be dealt with on emergency lines, invoking the aid of the administrative services and leading, in the palm disease campaign, to legislation of the kind that is familiar in more advanced countries, where it becomes an actionable offence to own a diseased plant without reporting or dealing with it as prescribed. In the campaign against this disease, which was exterminating the palmyra in an area where this was the dominant tree and by far the most useful,* nearly a million diseased palms were cut out to save the rest. This and the subsequent legislative action and the discovery that many trees could be saved by removing the bud sheaths in the early stages of attack have been successful in preventing the spread of the disease and in keeping it within manageable proportions. The campaign cost the Government about £20,000; but the value of the palms cured by treatment was estimated at about £28,000 in 1921, and the number saved from infection must run into millions.

In other cases it soon became evident that the variety of the crop grown was exceptionally liable to disease either because of inherent susceptibility or because disease had been allowed to accumulate in the stock and was being transmitted when diseased material was used for planting each successive crop. In such cases the agriculturists of the department, each of whom had a district under his charge, became invaluable collaborators, both in observing the injury done to particular varieties and in introducing new or more healthy ones.

Then there were the cases where one had to make a direct attack on the parasite and try to kill it or to prevent its spores germinating by the use of fungicides. This at once brought one face to face with the economic limitations of village agriculture in countries like India, where the cultivator usually has little actual money at his disposal and can only borrow at exorbitant rates of interest.

Copper and sulphur have remained to the present day the chief weapons in the hands of the plant pathologists in their direct attack on fungal parasites. In India they have been used chiefly on the more valuable orchard and garden crops or as seed disinfectants on field crops.

* An ancient Sanskrit poem professes to enumerate eight hundred and one separate uses for the palmyra palm.

The relative infrequence of destructive epidemics of disease amongst indigenous crops in the tropics as compared with the great plantation crops is not due, I think, as is sometimes assumed, to the circumstance that the latter generally occupy larger continuous areas under the one crop, so that disease germs can multiply and infect more readily. In India there are large areas of village lands mainly under a single crop, as rice in 70 per cent of the cultivated land in parts of Bengal or cotton in 60 per cent of Khandesh. Freedom from disease in these cases is probably mainly due to disease resistance having become, through long experience, the determining factor in the selection of the varieties grown, the quality of which is liable to be a secondary consideration and is often decidedly low. In the plantation industries, on the other hand, quality which will enable the produce to compete in the markets of the world is so important that hardiness may be sacrificed. Examples of destructive epidemics in these crops are numerous and are not, as in the other category, usually due to newly introduced parasites. They are just as often due to an old parasite finding in a new variety a congenial host. They are sometimes also due to the considerable financial return leading to expansion of a plantation system into areas not naturally affording optimum conditions for the growth of the plant, so that its environment may become more favourable to the parasite than the host.

The recent wave of epidemic disease that has ravaged the cotton plantations of the Sudan may perhaps find a partial explanation in these considerations. When the great Gezira irrigation scheme, due in its inception to the genius of Garstin and Kitchener, was opened in 1925, it was already established that the highest quality Egyptian long-stapled cotton could be successfully grown in this previously arid waste. At the present time, approximately 200,000 acres of irrigated Sakel cotton is grown as the major crop in the gigantic plantation of 600,000 acres under uniform control and cropping, surely the largest arable farm in existence. During the first five years after the dam was built across the Blue Nile, cotton worth more than £12,000,000 was produced from the Gezira, and 150,000 people had settled where before there was only a scattered famine-stricken population.

The cotton disease known as blackarm occurs in all the cotton-growing parts of Africa, but it seldom causes much injury to the varieties grown by the people of the tropical regions, and the long-stapled kinds grown in Egypt escape damage apparently because the climate of Egypt does not suit the parasite. In the Egyptian varieties grown in the Sudan it became a formidable pest, being one of the main factors in reducing the yield per acre from 479 lb. in 1925–26 to 129 lb. in 1930–31. This represents a loss of more than 60,000,000 lb. of cotton on the area grown in the latter year, worth even at the low prices then prevailing, more than £800,000. As the disease is carried mainly

on the seed, an elaborate scheme of seed disinfection with the dust known as 'Abavit B' was carried through before the last season's crop was sown, the whole of the seed for this great area, representing more than 30,000 bags, being treated by specially devised seed dusters. Various other steps were also taken to combat the disease, and the yield, when harvest was completed last spring, was found to have risen again to a little more than 400 lb. per acre, or not far short of that of the earlier years.

In this case there is far more at stake than the saving of an industry, however important. The whole future of a province is in the balance. I cannot refrain from quoting a foreign observer who visited the Sudan two or three years ago. "The Sudan is the latest thing in European exploitation and it is the best." There has been "created a corps of agriculturists and entomologists to destroy the pests that attack the native crops; a group of veterinarians to look after and improve the native cattle; and a quite unrivalled body of biologists, bacteriologists, laboratory workers and doctors to fight native diseases. Trekking through the land are the government biologists and entomologists, experimenting, destroying pests, noting processes, giving advice. You rarely find them in the same place for two weeks running; these hardy scientists do even more work in the open than in their laboratories."

The West Indies present a very different picture from the Sudan. There, in some of the oldest of the British Colonies, generations of planters and settlers have been engaged in the tropical and subtropical cultivations of lands favoured by Nature to an unusual degree. Jamaica is the largest banana exporter of the British Colonies, having sent out 24,000,000 bunches in 1930, representing more than 50 per cent of the total value of her exports. In 1912 the first cases of the now notorious Panama disease of bananas in the island were examined by S. F. Ashby. Rigid quarantine measures were promptly introduced by the Director of Agriculture, Mr. H. H. Cousins, impressed by the ruin from this disease which had befallen the banana-growing enterprise in the Dutch Colony of Surinam between 1906 and 1910. As soon as a diseased plant was discovered, it and all the surrounding ones on an area of four chains had to be destroyed and the area fenced in. As a result, spread was slow, the number of cases annually not surpassing 1000 until 1921. Increase since has been at the rate of about 50 per cent a year, until by 1929, there were about 85,000 cases, involving nearly 140,000 plants. In the parish of Portland, the most diseased, some 9000 acres, or approximately one-tenth of the total estimated banana acreage of the island, have now been abandoned, for it has been found that commercial banana growing is impossible on land once infected, and the great United Fruit Company has already abandoned nearly 100,000 acres from this cause in Central America. The expenditure by the Government of some £60,000 in Portland no doubt prolonged the life of the plantations by ten years or more, but in the end has proved unavailing.

As there is no direct method of fighting this disease, which is due to a soil fungus, attempts to procure resistant varieties are being energetically carried out both in Jamaica and at the Imperial College of Tropical Agriculture in Trinidad. Varietal tests have shown that the Cavendish species of banana and some others are either highly resistant or totally immune. Botanists both from Kew and the West Indies have toured the world in search of varieties for trial and hybridisation and these are grown under quarantine and inspection at Kew before being sent on to Trinidad. Very large numbers of crosses have been made in Trinidad and Jamaica and some of the immune seedlings produced in the latter island have given bunches which were acceptable to the trade during the past year. The Trinidad seedling I.C.1 (Imperial College No. 1), a cross between the commercial Gros Michel and a wild species, has also shown remarkable immunity during six years tests, but the fruit still requires improvement.

It is estimated that within the next five to seven years, at the present rate of increase of the disease and the amount of suitable banana land left, the Jamaican export will begin to decline, and the decline is likely to be rapid unless a satisfactory resistant variety can replace the Gros Michel. The breeding work is difficult and slow. It is not easy for the stricken farmers to be patient. The whole population in the coastal parts of the parish of Portland has been brought up to the cultivation of the banana before anything else, and though an alternative crop of marketable value is desperately needed, it will take a long time to break down prejudices in a one-crop population. Many of the people have migrated, but many have remained to make a living as best they can. It is cold comfort to tell them, as there have not been wanting even scientific men to say, that these coastal lands, extraordinarily fertile though they be, are unsuited to the banana because the damp soil favours attack by Panama disease. The local Department of Agriculture has never taken that view but has striven hard to fight the disease, and the extra lease of life that it has given the industry, though insufficient in Portland, may yet save the banana cultivation of the island as a whole.

In the examples selected to illustrate the importance and control of the diseases of tropical plants, there is every gradation in severity from the sorghum smut which levies a moderate toll of about ten per cent of the crop on some millions of acres in India, to the Panama disease which completely exterminates the susceptible bananas and precludes replanting within any reasonable time. The success of the measures which have been adopted to control these diseases also shows every gradation from the complete control which is easy to obtain by disinfection against sorghum smut or by growing Cavendish bananas in Panama-diseased land, to mere alleviation which appears to be all one can hope for, but is yet sufficient,

against rubber mildew or the root diseases of limes. A consideration of these measures—ruthless eradication, the complete replacement of susceptible varieties, hybridisation or selection to obtain resistant plants, budding or grafting on resistant stocks, modifications in agricultural practices like stubble burning or pre-watering, and, finally, the direct attack on the parasite by steeping, spraying or dusting—indicates how varied is the task of the plant pathologist and how wide must be the foundations of his knowledge if he is to perform it successfully. The old conception of the mycologist, student of the fungi that cause disease, as adequately equipped to fulfil the duties of a plant pathologist, dies hard but it is dying. Like bacteriology in the realm of medicine, pure mycology is a necessary foundation and the mycologist a necessary collaborator, but he is not equipped either as a general practitioner or a specialist in particular diseases.

The practical man is often slow to admit that a destructive disease in a plant is due to agencies outside his control. Confronted with such he is inclined to seek for explanations other than the true one. He looks first for some disorder brought about by cultivation or inbreeding, or meteorological phenomena. Or he thinks that the soil is unsuitable or has become exhausted, or that the plant, if an exotic, has failed to become acclimatised. It is often not until all these have been tested and found wanting, that the true cause is fully realised. Experience has shown that it is unfortunately rare to find the explanation of serious disease in these directions and the dominating factor is usually the presence of a parasite, however much its activities may be favoured by secondary causes.

Failure to recognise the very varied weapons used by modern plant pathology and undue weight given to the secondary factors in the causation of disease have led, no doubt, to the suggestion which I have heard that the 'mycologist', as he is still called in most of the British Colonies, may be in danger of losing his position as one of the most essential members of any team of tropical research agriculturists. In actual fact there can be no question that, looked on as a member of a team and relying on the collaboration that must exist between him and the plant breeders and agriculturists, the plant pathologist is more needed now than ever. Improvement in the crops of the people and the quest of quality or the satisfaction of market fancies in the plantation crops can be relied on to be followed by increase in disease. Unless plant pathologists well versed in the pathology of the crop concerned are available—and they cannot be produced at a moment's notice—the examples I have given will be paralleled in every Colony in the British Empire.

The Cambridge Philosophical Society

THE Cambridge Philosophical Society was incorporated in 1832, by Royal Charter, through the grace and favour of William IV, and the centenary of that event has been celebrated recently. (See NATURE of November 19, p. 769.)

The history of this scientific organisation, which has maintained a high standard in past years, and remains unfailingly hopeful of the future, should be of interest, not only to historians of science, but also to laymen. The Cambridge Philosophical Society is of older origin than its royal grant by some twelve or thirteen years. In October 1819, as the outcome of conversations amongst a few interested persons, a notice was issued, signed by thirty-three members of colleges, inviting assistance in promoting a society "as a point of concourse for scientific communications". Success having followed this venture, the designated name was approved, rules were made, and a council elected for the year ensuing. The Chancellor of the University, H.R.H. the Duke of Gloucester, accepted the office of patron; that of president being assigned to the Rev. William Farish, Jacksonian professor of natural and experimental philosophy. In all the foregoing movements, Prof. A. Sedgwick, J. S. Henslow (afterwards Prof.), and Dr. E. D. Clarke (professor of mineralogy, 1808–22), were prominent. At an inaugural gathering, the last-named gave an address on the new project (separately distributed*). Reference was broadly made to the philosophical contributions of members of the University as being hitherto "frittered and squandered away" in detached and distant parts, almost to be without existence.

The first half of the nineteenth century witnessed the establishment of many scientific societies. The apprehensions of Sir Joseph Banks for the welfare, even the continuity of the parent tree, the Royal Society, were seen to have been needless, and indeed, at his death, in 1820 (whilst in office), however chequered in progress certain of the newcomers were, the writing was already on the wall in regard to alarmist notions. Among the new bodies were: the Horticultural (1804), Geological, London (1807), Geological, Penzance (1814), Institution of Civil Engineers (1818), Astronomical (1820), Zoological (1826), Geographical (1830), Entomological (1833), Chemical (1841). Cognate organisations were formed at Manchester, Glasgow, Hull, and other centres. Neither in the perplexing era of the seventeenth century, nor in the industrial nineteenth, were scientific societies born secure in the knowledge of powerful support. In all the instances above, initiation was *ex collegium*. In the case of the Cambridge Society, there certainly was an ample measure of University support and

*The Patent Office Library, London, possesses a copy (bound) on the title page of which is the pencilled signature, "J. Henslow, 1821," and there are textual annotations in the same hand.

favour, coupled, by the way, with financial help from the syndics of the University Press.

A few words are due to the Rev. W. Farish, first president of the Cambridge Philosophical Society. Born in 1759, he was educated at Carlisle Grammar School. He graduated in 1778, being senior wrangler and first Smith's prizeman. Farish was instituted Jacksonian professor of natural and experimental philosophy in 1813, succeeding the Rev. F. J. Hyde Wollaston, a brother of William Hyde Wollaston. Earlier (1794) Farish had been chosen professor of chemistry. In 1796 he published a plan of a course of lectures on arts and manufactures in relation to chemistry, a scheme in all likelihood derived in the main from his predecessor, who himself was responsible for "A Plan of a Course of Chemical Lectures". Farish was the author of six papers read before the Society, one of them (1820) under the title "On the Mode of Conducting Polar Navigation".

Space would forbid other than cursory notice of memoirs read in the first half-century of the Society's career. The chief publication began in 1820, entitled *Transactions*, supplemented in 1843 by *Proceedings*. They both enjoy a world-wide circulation now. In the spring of 1820, J. F. W. Herschel communicated three papers, and in 1835 came letters from the Cape of Good Hope detailing meteorological observations made there by him. Similarly, at the same meeting, letters were read from Charles Darwin containing accounts of the geology of certain parts of the Andes and South America. Very much later (in 1860), Darwin is writing thus to Lyell: "I had a letter from Henslow this morning, who says that Sedgwick was . . . to open a battery on me at the Cambridge Philosophical Society. Anyhow, I am much honoured by being attacked there, and at the Royal Society of Edinburgh". Faraday had written in 1823 accepting honorary membership. Airy, whilst yet a student at Trinity College, communicated a paper, followed by others, down to 1840. Whewell provided many papers. But such records are readily capable of indefinite extension, reaching into another half-century, and that is not practicable. Suffice that the names of some of the best-known exponents of science in almost all departments appear in the lists of past presidents. We learn that to-day, tea before meetings, as in "another place", fortifies those numerous authors whose memoirs have, of necessity, to be "taken as read". The separate publication of *Biological Reviews and Biological Proceedings* is an undertaking of recent years which has proved of great value.

It is of interest to record that at the annual general meeting in 1895, Prof. J. J. Thomson, president, in the chair, the subjoined resolution was adopted: "That the Fellows of the Cambridge Philosophical Society at this their first meeting since the death of Professor Thomas Henry Huxley desire to express their sympathy with Mrs. Huxley, and to record their sense of the depth of his influence on modern thought, and on the progress of biological science".

In its youthful period, aided by the lively interest of Prof. Henslow, the Society took pains to form collections exemplifying natural history. In process of time this important nucleus of a great museum was given accommodation elsewhere (1865). There has been gradually brought together a reference library of most creditable size, and it includes numerous runs or sets of scientific periodicals. The adequate and safe housing of this library—none too well assured at present—is receiving attention.

The Cambridge Philosophical Society, unlike many other scientific institutions, has no trust funds of its own, and has never had the good fortune to receive a legacy or other special benefaction.

T. E. JAMES.

Obituary

SIR DUGALD CLERK, K.B.E., F.R.S.

BY the death of Sir Dugald Clerk on November 12, following comparatively closely on that of Sir Charles Parsons, Great Britain has lost the two greatest engineers in history, at least in the field of power production.

To the imagination, to the detailed scientific research and still more to the lucid and admirable teaching of these two men, are due the whole modern system of power production as we see it to-day, on land, on the water, and in the air. Just as Sir Charles Parsons by his development of the turbine revolutionised and revived the use of steam until none but his methods are employed to-day, so Sir Dugald Clerk nursed the internal combustion engine almost from the day of its birth as a sickly infant of little more than medical interest, nursed and reared it, until to-day it has become the greatest factor in modern engineering—indeed one might almost say in modern civilisation. In the early stages of its infancy, when 'doctors' differed and none knew how to feed or tend it, it was Clerk who first explained to the faculty how its delicate interior functioned, how its growth and strength could best be fostered, and where its frailties lay. Since that day, Clerk watched ceaselessly over and reared this child and its offspring through many generations, until to-day it has peopled the earth, the sea, and the sky. Many thousands of 'doctors' in all the countries of the world have since adopted and specialised in the care of this fertile breed, but one and all, consciously or unconsciously, have drawn their inspiration and their methods from the teachings of Sir Dugald Clerk.

We are prone to set great store by invention, and Clerk's inventions in this field were many and important, the best known perhaps being that

of the two-stroke cycle engine; but inventors are plentiful and inventions mark phases only. The great value of Clerk's work lies rather in his brilliant analyses of the working processes, in his lucid presentations of these in a form which appeal alike to the student, to the purely scientific investigator, and to the practical engineer—these will live for ever.

In his earlier work Clerk could rely for his observations only on the very imperfect and erratic instruments which were available, but he sifted and supplemented these often conflicting observations with such judgment and insight, and with such a breadth of imagination, that all his deductions have stood the test of time and hold good to-day.

The value of Clerk's scientific work was enhanced greatly by the extraordinary charm of his personality, by his kindliness and encouragement and by the almost limitless trouble he took to assist and encourage all the younger generation. My first meeting with Sir Dugald Clerk was some twenty-five years ago. As a very young man I had invented, or thought I had invented, an improved type of engine; I had submitted this invention to a manufacturing firm, who had referred it to Sir Dugald Clerk. Sir Dugald sent for me and explained that, reluctantly, he had turned down my invention; he explained exactly why and urged me not to be discouraged—he suggested many ways in which the idea could be improved, and invited me to call on him at any time for any help or advice he could give. At once I fell a victim to his charm and the obvious sincerity of his kindness—a kindness which he bestowed on me from that time until the day of his death.

Too often one has to record the great work of a man left unrecognised and unappreciated until after his death. Fortunately this does not apply in Sir Dugald Clerk's case: his work was known and recognised all the world over and he was honoured, as was his due, by the leading scientific institutions of his day and by his innumerable friends and admirers. His scientific lectures were always a joy to attend, not alone for the value of the material they contained, but also for the sheer joy of listening to his beautiful diction and his pleasant voice.

H. R. RICARDO.

MR. T. G. SLOANE

THOMAS GIBSON SLOANE, of Moorilla Station, Young, New South Wales, who died on October 20, combined the unusual association of sheep-breeder, philosopher, naturalist in general and entomologist in particular. One of five sons of Alexander Sloane, of Mulwala, Murray River, a well-known merino expert, he was educated partly at the Scot's College, Melbourne, partly by tutor at home. There was a strong literary taste in the family, and a fine knowledge of the English poets was a background of his well-stored mind. He was sent to Sydney to learn business methods and returned to manage Moorilla for the firm of Alexander Sloane and Sons, which he inherited as his life-long home. Here he won numerous prizes for sheep at various shows; had a stud of his own registered in the flock book; kept accurate records of wool weights and was a regular attendant at Sydney sheep sales.

In Sydney, however, Sloane also met Sir W. Macleay and his scientific henchman, the late J. J. Fletcher, who became his lifelong friend; and in 1888 contributed his first paper on Carabidæ to the Linnean Society of New South Wales. Natural history was his passion, and I have never met any man who so closely and enthusiastically studied Darwin, especially "The Origin of Species".

As an entomologist Sloane was soon recognised as the Australian authority on the Carabidæ, though he later included the Cicendelidæ in his studies. But his mental horizon was too wide to allow himself to be limited to collecting and describing new species. Phylogeny and distribution greatly occupied him. His paper on the "Faunal Subregions of Australia" has often been quoted by later authors, while his "Classification of the Family *Carabidæ*" (*Trans. Ent. Soc. London*, 1923) has received wide notice. Sloane's "Table of Tribes" has been adopted as being the most satisfactory classification in existence.

Sloane contributed some sixty-one papers to various societies—the great majority to the Linnean Society of New South Wales—and described 595 new species, of which 557 were Carabidæ, including a few from New Guinea. With a world-wide correspondence, he found time to help his brother entomologists generously by naming their collections, until later years brought those economic worries that have especially troubled Australian pastoralists.

I accompanied him on many a distant trip through Queensland, Western Australia, New South Wales and Victoria. He was a delightful companion and a lovable friend, with an unlimited stock of yarns, and a good 'mixer' with bush folk, whom he understood. A retentive, but not a wide, reader, he avoided modern fiction, but collected a good library especially on Australian exploration and traveller naturalists. Generous in excess to others, sparing in his own needs, a stoic by nature and will, his last years were spent in hard work on his homestead. He passed away at the Burrangong Hospital, Young, a victim to cardiac asthma, leaving a widow, two sons and four daughters to mourn his loss.

H. J. CARTER.

MR. G. B. SCOTT, C.I.E.

BY the death of Mr. G. B. Scott, which took place at Bournemouth on November 20 at the age of eighty-eight years, a distinguished Indian frontier surveyor passed away.

Scott's memory carried him as far back as the stirring times of the Second Sikh War. He was educated at the Lawrence Military Asylum at

Kasauli, through which place, as a boy of thirteen years of age, he saw the British regiments march on their way from Simla to take part in the siege of Delhi.

Scott joined the Survey of India in 1863, and then began an adventurous career on the North-West Frontier. His camp was attacked by the tribesmen on several occasions and he had more than once to repel, with his small guard, determined onslaughts of much larger numbers. On one occasion in particular, he repulsed an attack of several hundred Allahiwals while he was on survey duty, having with him a guard of only twenty sepoys. For the gallantry he displayed on this occasion he was rewarded by Government with an honorarium and a sword of honour.

Some years later Scott repulsed a determined attack on his survey party by the Mohmands while at work in the Khyber Pass. He had to fight his way back to Fort Michni, losing three killed and four wounded, one of which he carried out of fire. He took part in the Black Mountain, Jowaki-Afridi and the Zob Valley expeditions, as well as the Second Afghan War.

Scott did some valuable work in map compiling at army headquarters at Simla, which earned him, in 1885, the commendation of the Commander-in-Chief (General Roberts). After five years surveying in Upper Burma he was appointed in 1894 to be superintendent of Land Record Surveys in the United Provinces, a post which he retained until his retirement in 1901.

This, however, did not end Scott's career, for he was employed to superintend the Cadastral Surveys in the Bundelkhand States of Central India. From 1910, for nearly three years he was surveying for the Anglo-Persian Oil Company, in West Persia, and in 1912–13 was engaged on the survey of tin mines in the Karenni country of south-east Burma.

Scott was the author of a Pushto vocabulary, "Twenty Years on the North-West Frontier", "Afghan and Pathan" and "Religion and Short History of the Sikhs". He was the holder of two medals and four clasps, and in 1914 the Companionship of the Indian Empire was conferred on him. He was much liked by everyone who had the privilege of knowing him.

H. L. C.

WE regret to announce the following deaths:

Viscount Dillon, C.H., who was president of the Society of Antiquaries from 1897 until 1904, on December 18, aged eighty-eight years.

Prof. John Glaister, emeritus professor of forensic medicine in the University of Glasgow, whose best-known textbook was "Medical Jurisprudence, Toxicology and Public Health", on December 18, aged seventy-six years.

Dr. W. J. Holland, emeritus director of the Carnegie Museum, Pittsburgh, known for his work in museum administration and entomology, on December 13, aged eighty-four years.

Mr. H. A. Roberts, for more than thirty years secretary of the Appointments Board of the University of Cambridge, on December 18, aged sixty-eight years.

News and Views

Bicentenary of Sir Richard Arkwright, 1732-1792

ON December 14 at the Science Museum a public lecture was given by Mr. F. Nasmith, under the auspices of the Newcomen Society, to commemorate the bicentenary of the birth of Sir Richard Arkwright, the inventor of the spinning machine known as the water frame and the founder of the factory system of cotton manufacture as we know it to-day. In introducing Mr. Nasmith, Mr. H. W. Dickinson, president of the Society, said that it is one of the aims of the Society to direct attention to the great inventors and engineers who are among the world's chief benefactors, and it is of interest to recall the remark of Lecky the historian, who said that it was largely the cotton mill and the steam engine which enabled Great Britain to stand the strain of the Napoleonic wars, and that Arkwright and Watt deserved statues as much as Wellington and Nelson.

To understand fully the remarkable influence of Arkwright's work on the development of the factory system in the cotton industry, Mr. Nasmith said it is necessary to realise the conditions which prevailed when he commenced to take an interest in spinning. Textile manufacture when he was born was a purely domestic industry, carried on by manual labour and with crude appliances. Turning from his barbering and wig-making, Arkwright learnt all he could about spinning and in 1769 took out the patent which laid the fortunes of himself and hundreds of others. The novel feature in his new spinning machine was the use of several pairs of rollers for drawing out the cotton fibres before they were spun, and this principle is applied on a very extended plan to-day. But he was more than an inventor, for he envisaged and put into action the plan of setting out in ordered fashion in one building machines, different in character and design, and driven by mechanical power, arranged to secure a continuous flow of material from the raw state through the various processes until it emerged a finished yarn. This idea of a complete cotton-spinning factory shows genius of a high order and Arkwright may be regarded as the 'first master cotton spinner'. Arkwright, it may be added, died at Cromford, Derbyshire, on August 3, 1792, at the age of fifty-nine years. His portrait by Wright is in the National Portrait Gallery.

Cancer Research at Nottingham

AT the annual meeting of the Court of Governors of University College, Nottingham, on December 15, under the presidency of His Grace the Duke of Portland, it was reported that a scientific research fellowship had been founded through the generosity of Mrs. Massey and Mrs. Massey Stewart. The purpose of the fellowship is to develop the physical methods for the diagnosis and cure of cancer. The Council appointed to this fellowship Dr. L. A. Woodward, who has had a distinguished career at Oxford and Leipzig. The local branch of the Imperial Cancer Campaign has made contributions of £500 for the purchase of additional instruments required and £50 to cover travelling expenses in connexion with the investigations. Accommodation has been found for the fellow in the Department of Physics, and the general equipment and facilities of the Department will be available for his use. The assistance of a biochemist in Dr. Woodward's work has been secured by the appointment of Dr. H. H. Barber, towards whose salary the Nottingham branch of the British Empire Cancer Campaign is contributing a sum of £100 a year for a period of three years in consideration of this assistance. A Joint Cancer Research Committee has been set up, consisting of the Principal, the heads of the Departments of Biology, Chemistry and Physics, and Dr. F. H. Jacob, Dr. R. G. Hogarth and Dr. A. M. Webber as representatives of the local branch of the British Empire Cancer Campaign.

Science and War

IN a speech delivered in the House of Commons on November 10, which has been reprinted by the *New Commonwealth* under the title "The Warning", the Right Hon. Stanley Baldwin deals with the moral and ethical consequences of the application of scientific discoveries or inventions to destructive purposes. Science has completely transformed the character and offensive powers of modern warfare. To the air attack there is no possible defence save in counter-attack, and aviation affords an outstanding example of an instrument of war the consequences of which are so terrible and deadly that the safety of mankind lies in the renunciation of its use. So far as the air is concerned, Mr. Baldwin agrees that only the abolition of flying offers any prospect of complete disarmament. Prohibition of the bombardment of the civil population and reduction of the size of aeroplanes are suggestions that are unlikely to stand the stern test of war. The abolition of flying is, however, an inconceivable step. Mankind has never yet consented to forego a new power which he has once claimed and the practical question which remains is the use to be made of this new power. Mr. Baldwin suggests that a thorough investigation of the problems involved in the international control of aviation is called for, apart altogether from the possibility of abolishing all air forces. Scientific workers should be among the first to respond to the moral appeal underlying Mr. Baldwin's speech, that with the winning of new powers for mankind there should be won also a finer sense of moral responsibility and a determination to oppose the prostitution of such powers to base purposes. Only such a sense of values and of responsibility on the part of every individual citizen can save mankind from the destruction and disorder which seem the inevitable outcome of the present state of international relations.

The Royal Dublin Society

IT is recorded in the *Irish Times* of December 2 that Viscount Powerscourt has taken over the office of president of the Royal Dublin Society, in succession to Prof. J. Joly, whose term of office (three years) has come to an end. In the course of his Lordship's remarks, Lord Powerscourt, who is a leading member of the Agricultural Section of the Society, stated reasons for believing that the policy of the present governing body in Ireland must result in very grave effects upon the agricultural work of the Society. These fears are supported and very strongly emphasised by Dr. Bohane, the official director of the Society, in the *Irish Times* of December 3, whose remarks are mainly directed to financial considerations connected with the agricultural work of the Society. We are informed by Prof. Joly that the scientific work of the Society must also suffer seriously, seeing that the Society expends considerable funds in support of scientific research and on the publication of its *Scientific Proceedings and Transactions* as well as on fees paid to experts who lecture upon scientific subjects in various rural districts of Ireland. The Irish Radium Institute—which is legally affiliated to the Society—must also suffer, considering that the distribution of radium emanation devolves upon a senior and highly responsible member of its paid scientific staff. Those who wish for a full account of the Society's work at the present day will find it detailed by expert members of the Council in a volume issued recently in commemoration of the two-hundredth anniversary of its work for the prosperity of Ireland.

Statistical Method of Control in Industry

AN important aspect of the part which statistical method may play in industry in the improvement of the production process and in increasing efficiency in the fitting of supply to satisfy the wants of the consumer was discussed on December 20 at a meeting of the Royal Statistical Society, when Dr. E. S. Pearson contributed a paper on the statistical control of quality in mass-production industry. Whether the manufacturer is concerned with the tensile strength of malleable iron, the length of life of lamps, or the durability of cloth, he cannot succeed in producing exactly the same article again and again. Quality must, in fact, be expressed not only by an average but also by some measure of variation about this average. Yet if this is so, it is also important that there should be uniformity in this variation. For example, if the variability in the length of life in electric lamps can be reduced below a certain level, this may be of little value to the ordinary householder; but a large-scale consumer such as a borough council may then find it a more economic proposition to

renew all its street lamps after a fixed number of hours of burning than to wait till each lamp burns out, and then send a man to replace it. For a number of years individual firms have here and there made use of statistical theory in laying out efficient research programmes to improve the quality of production or to establish sampling plans to reduce the cost of inspection. But it is only in the last few months that an attempt was made to organise concerted action, when the British Standards Institution appointed a small committee to investigate the problem from the point of view of standardisation and specification. Direct contact between the industrialist and the statistician is of first importance. The former has not hitherto fully realised the potentiality of the statistical tool, while the latter has not understood the lines along which theory could be most helpfully developed.

The Roman Wall in Scotland

AT the Friday evening discourse on December 16 at the Royal Institution, Sir George MacDonald discussed the Roman Wall in Scotland. So far as its chances of survival were concerned, the Wall was unfortunately situated. Stretching, as it did, from Forth to Clyde, it ran, for the most part, through arable land and also traversed what was destined to become a great industrial belt. Nevertheless its remains are still considerable. The date of its erection was about A.D. 142, soon after the accession of Antoninus Pius, and it is quite certain that it was abandoned before the end of the century. Soldiers say that, as a piece of military engineering, the line which it followed was admirable, much superior to that selected for the Wall of Hadrian. The barrier consisted of three main elements—a rampart, a ditch, and a military road—and there were nineteen supporting forts, planted at intervals which averaged two miles in length. Despite its excellent construction, the road has been destroyed almost everywhere. On the other hand, the ditch, which was usually about 40 ft. wide and 12–15 ft. deep, has left an enduring mark. Even where it has been entirely filled in, digging will always reveal its position. Within the last twenty years its course has been determined for practically the whole 37 miles of its length, and this will be noted on future issues of the Ordnance Survey maps. A group of seventeen inscriptions, unique in the Roman world, yields extremely interesting information as to the distribution of the work among different bodies of legionaries. The purpose of the Wall is often misunderstood. What it contemplated was not a state of war, but a state of restless peace. Excavation has proved that the forts were twice evacuated and twice restored before the final abandonment, and has also brought us to some extent into personal touch with the men who maintained the *pax Romana* in North Britain in these troublous days. They were not Romans, in the strict sense of the term, but a motley crew, levied chiefly in Gaul and the Low Countries, having Latin as a common language and welded into a unity by iron discipline.

A New Academy of Sciences in Western China

THREE years ago there was organised in the Little Gorges near Chungking of Szechuan province an Academy of Sciences of Western China. This institute is supported primarily by private contributions. It has now an annual budget of 40,000 Mexican dollars. Research and survey work along the lines of geology and biology will be pursued in the Academy. At present, with the help of Dr. H. H. Hu, director of the Fan Memorial Institute of Biology at Peiping, a herbarium and a botanical garden have been established by the Academy, with the view of exploring botanically all parts of that vast province and eastern Tibet, and collecting seeds, cuttings, and bulbs, etc., for planting in the botanical garden. It is intended shortly to establish a nursery where seeds and bulbs will be provided for sale or exchange. For example, the collector was instructed to collect seeds of *Rehderodendron*, a new genus of three species of ornamental trees of Styracaceæ, recently described by Dr. Hu. Seeds of other interesting and ornamental plants will also be collected. The Arnold Arboretum of Harvard University will be the first botanical institute in the United States of America to share a part of this collection. This year two parties have been sent out by that institute to collect herbarium specimens and seeds, one to eastern, another to south-western Szechuan. The latter is exploring the bordering districts along the Szechuan-Yunnan-Tibet borderland. In the winter the collector will bring herbarium specimens and seeds to the Fan Institute for study and identification, as that institute has a large herbarium and a large botanical library, and furthermore a unique collection of some 17,000 photographs of the type-specimens of Chinese and other Asiatic countries taken in various European herbaria.

"Terrestrial Magnetism and Atmospheric Electricity"

THE September issue of *Terrestrial Magnetism and Atmospheric Electricity* forms a memorial number in honour of the late Dr. Louis A. Bauer, who founded the journal in 1896 and edited it almost until his death early this year. It contains two admirable portraits of Dr. Bauer. The number is of unusual length, containing 220 pages, and (besides subsidiary matter) thirty-seven articles by authorities on terrestrial magnetism and electricity from all over the world. Some of these are of unusual interest, and among them may be mentioned those of Adolph Schmidt, J. Bartels, and L. Vegard. Schmidt deals with the secular magnetic variation, and shows that many of its larger features can be explained in a simple way as due to the rotation of a component of magnetic polarity, about an axis through the points where the Greenwich meridian crosses the equator, so that the poles of this component move in the meridians of longitude 90° and 270°, the complete rotation taking about 480 years. This simple conception explains the main features of the secular variation but does not agree so well with the long-continued decline of the earth's magnetic moment during several decades past. The article by Bartels

is on statistical methods for research on diurnal variations, and contains both important conclusions and interesting suggestions for future work in this difficult field.

THE paper contributed by Prof. L. Vegard is a brief account of an investigation of the temperature of the auroral region by the use of the rotational series of the negative nitrogen bands, shown on auroral spectra obtained by long-continued intermittent exposures over several weeks or months. The results obtained in two different ways agree in giving the value of 240°K. This is much lower than the high temperature for this region first proposed by Lindemann and Dobson on meteoric evidence, and confirmed by the abnormal propagation of sound, by reflection at a height of about 40 km. In this connexion, Vegard mentions experiments he has made tending to show that the laws of propagation of sound at low densities are different from those that apply at normal densities. The paper is an interesting contribution to a controversial subject. Another interesting paper, by Prof. V. F. Hess, reviews the present state of knowledge concerning cosmic rays, mentions the co-operative scheme of work started on his initiative in order to examine whether the irregular fluctuations of the rays occur simultaneously in different places, and gives some preliminary results of the work of his cosmic ray observatory on the Hafelekar ridge, near Innsbruck.

Exploration of the Upper Atmosphere

THE International Commission for the Exploration of the Upper Atmosphere has recently published the collected results of upper air work done during 1924, under the title "Comptes Rendus des Jours Internationaux, 1924". As in the case of the first and pioneer volume of the kind, for 1923, the compilation has been made under the supervision of Sir Napier Shaw, honorary president of the Commission; the 1924 volume has unfortunately been delayed by his illness, and by financial difficulties. The latter have been lightened by the use of the Replika process in the production of the volume, the price of which is 45*s.*; the later volumes (of which that for 1925 has already appeared, under the title "Ergebnisse der Aerologischen Messungen, 1925"), are being published by Prof. Hergesell, president of the Commission, at the regrettably high price of 60 gold marks. The present volume is in two parts, one containing tabular details of the ascents of sounding balloons, together with synoptic charts for the international days, and the other containing 'tephigrams' representing graphically the results of individual ascents.

Rainfall and Water Supply

IN an article by F. J. Garland entitled "Rainfall and Water Supply" in *Progress and the Scientific Worker* for September and October 1932, stress is laid on the importance of the work of the voluntary rainfall observers whose records supply a very large proportion of the material for the annual volumes of "British Rainfall", the old-established publication of the British Rainfall Organization now compiled by the Meteorological Office. The article contains interesting facts about springs and artesian wells, and some particulars about the practical side of the engineering problems involved in conveying water to distant towns from catchment areas. On these subjects the writer is on his own ground, but when he passes to purely meteorological matters connected with rainfall, some very inaccurate statements are made. Thus, he says (p. 49) that the greatest recorded rainfall in England in 24 hours may be taken to be about three inches. The annual volumes of "British Rainfall" show however that falls greatly in excess of three inches occur in most years; that 9·56 in. fell in one day in 1917 at Bruton, Somerset, and 9·40 in. at Cannington once in 1924. The incorrect statement is also made that there is no satisfactory record of the amount of rain that fell during the Louth cloudburst of May 29, 1920, whereas, thanks to the records of voluntary observers, enough information was available for the rainfall to be mapped by means of isohyetal lines for the whole area of the storm, and this information is available not only in "British Rainfall" for that year, but also in the report of the special investigation undertaken by the Meteorological Office (Professional Note, No. 17, of the Meteorological Office. London: H.M. Stationery Office).

Scots Pine Timber

BULLETIN No. 15 (Dec. 1931) of the Forest Products Research Laboratory deals with a detailed analysis of "The Timber of Home Grown Scots Pine (*Pinus sylvestris*)". The primary considerations in connexion with the utilisation of home grown Scots pine, the resources of which timber in Great Britain were so depleted during the War, are the general grade of the timber and its mechanical properties. The investigations which have been undertaken at the Laboratory indicate that the home grown timber in different localities varies considerably in weight, and ranges from 25 to 45 lb. per cub. ft. at a moisture content of 12–15 per cent. The darker colour of the heart wood, which is an indication of the durability, is more marked in the home grown than in the imported timber, while the percentage of heart wood is dependent on locality and age. The average rate of growth of the timber in the four consignments examined varied from 4 to 23 and the average of individual consignments from 7 to 12 rings per inch. The bulletin deals in sections with structure, seasoning, mechanical and physical properties, antiseptic treatment, working and utilisation, and pests of the species. One of the problems facing the newly formed plantations of pine in Great Britain is to find or create a market for the small material which will come out in the early indispensable thinnings; while, it is pointed out, to produce best quality timber the time must be given to obtain at least 12 rings to the inch radius, and for lower grades at least 9 rings per inch are necessary. Straight-grained timber, as free from knots as possible, is demanded by the markets.

Illuminating Engineering

THE paper on the electric lighting of buildings read by A. B. Read and Dr. J. W. T. Walsh to the Institution of Electrical Engineers on November 3 illustrates the change that has come over the art of illumination during recent years. Originally the aim was to provide as much light as possible for the very limited consumption of energy available. Happily, owing to the great advances made in the means of light production, engineers are no longer trammelled by tradition and new and daring experiments are being made in illuminating engineering similar to those made possible in architecture and decoration, due to the use of new constructional methods and materials. The second part of the paper deals with the engineering and physiological principles which govern design and gives a brief description of the new materials now available to the 'artist in light'. Architects now provide electric 'points' on their plans not for 'a light of some sort' but for a fitting in character with the room. Lighting by electricity can be done in many ways. It can be used to enhance the restful atmosphere of a place of worship, dignify a great public building, serve as a decorative element in a small house, or bring sparkle and gaiety to a restaurant. The latest development in light production is the gaseous discharge tube. The use of various mixtures of the rare gases provides a wonderful range of hues in the light available. The efficiency of the lamp also has been greatly improved. It gives three or four times as much light as the ordinary tungsten filament gas-filled lamp. The authors conclude by discussing the effects of glare, contrast, shadows and colour. The paper proves that the task of the lighting engineer is a difficult one.

Report of the Strangeways Research Laboratory

THE Trustees' Report for 1931 on the Strangeways Research Laboratory, Cambridge, records as the outstanding event of the year the extension of the laboratory, made possible by a bequest of £5000 from the late Sir Otto Beit, and refers to the additional connecting links between the laboratory and the biological departments of the University which afford opportunities for valuable collaboration, for example, in zoology, nutrition and radiology. A résumé of the work in progress shows that Dr. H. B. Fell and her colleagues are carrying out with skilful technique investigations of great interest on tissue culture. Reference is made to the better results in the study of osteogenesis due to improvements in technique. Of the other work recorded we note Dr. P. D. F. Murray's studies on the development *in vitro* of the primary red blood corpuscles of the chick. Portions of fowl embryos removed from the egg after periods of incubation ranging from 1 to 18 hours were cultivated in a fluid medium composed of serum and embryo extract. Red blood corpuscles developed in all the cultures made from the posterior half of the primitive streak at the stage immediately preceding the formation of the head-process, but portions of the anterior half, although differentiating into central nervous system and somites, formed no blood. All the stages in erythrogenesis could be followed in the living material. The first sign was a thickening in the tissue; the cells of this thickening diminished considerably in size and displayed great mitotic activity. Eventually they lost their adhesiveness, formed loose groups in the tissue or fell into the culture medium as a cloud of free erythroblasts in the cytoplasm of which hæmoglobin began to develop.

Industrial Models at Hull Museum

THE crushing of linseed and rape seed obtained from the plants of northern Europe has long been a staple industry at Hull, which now claims to be the largest oil-mill centre in the world. In view of this, it is interesting to learn that the Museum contains a remarkable series of models of seed-crushing plant illustrating both old and new methods. The models were described in the *Model Engineer and Practical Electrician* in April last and the articles have now been published in pamphlet form as Hull Museum Publication No. 176. The models have been made by Mr. W. Marshall, who began his connexion with the industry as a blacksmith in 1869, rose to be manager of some of the largest mills and became a manufacturer of oil-mill plant. The beginning of the oil-seed industry is lost in the mists of antiquity but in certain parts of the world to-day very primitive plant is used. From these primitive devices came the lever press, the wedge press and the screw press, and in more modern times the hydraulic and steam power presses. These are all illustrated by Mr. Marshall's models, which are described in the pamphlet.

Publications of the University of Bombay

IN order to encourage research among teachers and students, the authorities of the University of Bombay have decided to issue a periodical publication, which will contain communications from members of the university and others dealing with research in the subjects of the University curriculum. The *Journal of the University of Bombay*, as the publication is to be called, will appear six times in each year, two of the parts being devoted to history, economics and sociology, two to arts and law, and one each to the physical sciences and the biological sciences. In addition to the original articles, there will be reviews of books, abstracts of academic theses and notes on current topics. The first issue, which has recently appeared, covering history, economics and sociology, contains several communications dealing with points in the history of sixteenth century India, India's trade and commercial relations, Indian art and sociology, the bearing of certain traditions on the origin of Konkan Brahmins, and articles of a more general character on trade unions and the League of Nations. Especially noteworthy is a lecture delivered in Bombay by M. Elie Faure on the interpretation of Indian art, in which it is suggested that a meeting-ground for Europe and India might emerge from their common inheritance from Greece. There is also an obituary notice of the late Sir Patrick Geddes, which does full justice to his work for India.

Infra-Red in Photomicrography

THE photography of small insects by transmitted light has hitherto been complicated by the necessity of employing screens transmitting only the red end of the spectrum, if detail of both body and wings is to be secured on the same plate. Recent improvements in the sensitising of plates to infra-red enable much darker screens to be used with relatively shorter exposures. An interesting example of this has recently been given by Mr. A. E. Smith (*Watson's Micro. Rec.*, No. 27) who publishes a photograph of a phorid fly in which the venation of the wings and the structure of the external genitalia are shown at the same time as the minute detail of body armature. The exposure of only five seconds through the almost opaque Ilford infra-red screen is a remarkable tribute to the speed of the plates, which quite evidently open a new field for the photomicrographic worker in all subjects.

Memorial to Prof. W. D. Halliburton, F.R.S.

ON December 17, Sir F. Gowland Hopkins unveiled a plaque which has been placed in the Halliburton laboratory of physiology at King's College, London, in memory of Prof. W. D. Halliburton, who was professor of physiology at the College from 1890 until 1923. When Prof. Halliburton was appointed, the laboratory was on the Embankment in small and badly lit rooms where Ferrier and Lister had worked. Yet, by his enthusiasm, he managed to attract many young physiologists to the College. The present laboratory is the result of his great efforts during his tenure of office as professor of physiology. Prof. Halliburton was elected a fellow of the Royal Society in 1891 and died on May 21, 1931, aged seventy years.

Duddell Type Oscillographs

THE Cambridge Instrument Co., Ltd., has issued a new list of oscillographs developed from the Duddell type (List No. 118). As usual in the catalogues of this firm, there is a valuable discussion of the design of the instruments, but the present list is noteworthy for the large number of examples of their use. These include the study of wireless 'echoes', of speech wave forms and of mechanical vibrations in turbine blading. In view of the modern development of large units in electrical engineering, there is a particular interest in the installations for investigating short-circuit and circuit-breaking phenomena and in the reproductions of very beautiful oscillograms obtained by their use.

Christmas Lectures at the Royal Institution

THE Christmas Lectures at the Royal Institution are to be given this year, starting on December 27, by Prof. Rankine. Prof. Rankine, who is president of the Physical Society, has carried out laboratory researches on the determination of the sizes of numerous gaseous molecules, as deduced from measurements of viscosity. During the War he investigated the possibilities of transmitting speech by light, using the selenium cell, and invented an instrument for this purpose, the photophone. In recent years his scientific work has taken him farther afield. He has been concerned in the latest developments of the science of geophysics, particularly in regard to its use in prospecting for minerals, including oil, and has made expeditions to Persia and Australia in connexion with this work. The subject of Prof. Rankine's lectures, 'The Round of the Waters', is full of possibilities. The subject lends itself to experiment in a great variety of ways, and this, the one hundred and seventh course of Christmas Lectures, should certainly not be wanting in interest and instructiveness.

Announcements

AT a meeting of the Royal Academy of Belgium held on December 15, Prof. P. Zeeman, professor of experimental physics in the University of Amsterdam, and Prof. T. Levi-Civita, professor of rational mechanics in the University of Rome, were elected foreign associates of the Academy.

THE Hopkins prize for the period 1924–27 has been awarded by the Cambridge Philosophical Society to Prof. G. I. Taylor, Yarrow research professor of the Royal Society, for his researches on hydrodynamics and on the deformation of crystals; and the prize for the period 1927–30 to Prof. P. A. M. Dirac, Lucasian professor of mathematics in the University of Cambridge, for his researches on the theory of quantum mechanics.

WE have received the report of the Victorian Bush Nursing Association for the year ended June 30 last. This Association, of which Sir James Barrett is secretary, provides trained nurses and other requisites for sick and injured persons in country towns and districts. It is run on a co-operative basis, a householder paying a small annual subscription, usually £1, and has 65 nursing centres and 29 cottage hospitals. Maternity and child welfare are important branches of the work. In spite of the financial stringency in Australia, the Association had a credit balance of £1,900 at the end of the year. Full reports are given of the activities in the various centres.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A male junior assistant metallurgist for the Royal Small Arms Factory, Enfield Lock, and a male junior assistant chemist at the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Central Office, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (Jan. 7). An assistant in the Department of Manuscripts and Records of the National Library of Wales—The Librarian, National Library of Wales, Aberystwyth—(Jan. 16). A University professor of physics at Birkbeck College—The Academic Registrar, University of London, S.W.7 (Feb. 10). A director (professor) of the Research Laboratory in Botany at the University of Madras—The Registrar, University of Madras, Triplicane, P.O. (April 1); further information from the High Commissioner for India.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

'Protective' Adaptations of Animals

WITH regard to recent correspondence in NATURE[1] following an article based on my paper on the effectiveness of protective adaptations,[2] I would remark, in the first place, that since neither Prof. Poulton, Prof. Huxley, and Mr. Nicholson appears to have seen my paper, their criticism should have been deferred. As to the points raised, I offer the following suggestions:

Prof. Poulton's main point would seem to be expressed in the following quotation: "To search with the compound microscope for butterfly wing-scales scattered through the contents of 80,000 avian digestive tracts would be a serious business, and if it had been accomplished I venture to believe that far more positive results would have been obtained." On p. 6 of my paper the use of compound microscopes in making all stomach examinations is noted. The alleged difficulty of identifying remains of adult Lepidoptera in bird stomachs is discussed on p. 59. Instead of encountering difficulty in recognising lepidopterous remains, I may say that when Lepidoptera have been eaten, the fact usually is evident to the practised eye at a glance due to the fuzzy felted appearance of the stomach contents caused by the distribution of hundreds of scales throughout the mass. The story is just as plain as that told by the contents of a killing bottle in which other insects have been carried with Lepidoptera; there seem to be scales enough to cover everything. If only a few scales were present, they might be missed, but in such cases in all probability the wing membranes with their characteristic venation, or the antennæ, head, or some other diagnostic part would be present and identifiable.

In 1912 I published the statement that remains of butterflies were found in only 5 out of 48,000 bird stomachs, while the 1932 paper records 87 from some 80,000 stomachs. Prof. Poulton now says that I attempt no explanation or defence of the earlier figures; on p. 60 of my paper, it is stated that all save 18 of the records pertain to a single bird, the pigeon hawk, and that the specimens of this hawk were taken at a point in a migration path of butterflies. The instance is a striking one supporting my general thesis as to the great effect abundance and availability of prey have upon choice of food by birds.

As a matter of fact, some of the other records also were from other hawks collected at the same locality (Fisher's Island, N.Y.), so that the 18 instances of butterfly captures by birds under supposedly normal conditions is still further reduced and the not alarming disproportion of 18 records for 80,000 to the 5 for 48,000 stomachs previously reported is correspondingly lessened.

Prof. Huxley's ship illustration, whether paralleling Nature or not, does not have his own confidence as he says, "Even if the proportionality [of destruction relative to type] were exact, it would have little significance." He pins his faith on the necessity of adaptations and says, "In general, the fallacy is that of forgetting that no species of organism could exist which was not a bundle of adaptations."

As to organisms necessarily being adapted, we find in almost every environment species of such diverse 'adaptations', if the use of that too meaningful term is permissible, as to prove that particular 'adaptations' cannot have been essential to survival. Huxley's picture of an organism that could not survive as one "conspicuous in colour and in habits, sluggish, palatable, juicy and soft, and with low fecundity" is in fact realised in some of the spiders—nevertheless they survive.

Quoting Prof. Huxley again, "The fact that 'some birds' . . . eat ants freely does not imply that ants are not rejected, relatively or entirely, by most birds." Ants are not rejected either relatively or absolutely by any potential predators. As nearly as may be, they are eaten by every kind of predator and freely by most of them.[3]

As to Mr. Nicholson's criticism, it appears to have little bearing. He says, "While it is evident that the book contains a vast array of statistical data on the contents of birds' stomachs, no mention is made of a similarly exhaustive survey of the food that was available to the birds, and, in fact, it is inconceivable that such a survey could be made adequately." Like my other critics, Nicholson had not seen my paper, hence does not know of the effort that was made in it to indicate the relative abundance of available prey. If he really believes that this information is unobtainable, then he should not criticise me for not presenting it.

Selectionists in an attempt to advance their cause have habitually appealed to unknown factors, and cited examples from largely unknown faunas (for example, of the tropics), to which doings Nicholson's remark, "such work can throw no light upon the process of natural selection", exactly applies.

The remainder of Mr. Nicholson's paper seems to have little application to mine. Nicholson is a mutationist, while the theory of natural selection during most of its history has relied chiefly on the preservation of small variations. As most critics of the theory have remarked, it is inconceivable that an initial slight variation in a favourable direction could have selective value. This is a fatal objection to old style natural selection theories all along the line. Whether there are enough 'large variations' or mutations to satisfy theoretical demands is another question which need not be debated here.

In general, as a reply to all critics, I would say that the importance of predators in controlling animal populations has always been over-rated. The grand factors are meteorological, and these as well as some of the other checks are by their nature barred as selective agents so far as 'protective adaptations' of the kind under discussion are concerned. This fact, in addition to consumption by predatory forms being very closely proportional to population, indicates that selection, if it exists at all is a force so weak that it cannot have guided the course of evolution so as to account for the structure and characteristics of all existing organisms in detail, which is practically what is attributed to natural selection by its extreme proponents.

I would emphasise that natural selection is still merely a hypothesis, and a vigorously challenged one at that. In 1894, Alfred Russel Wallace said: "It is of course admitted that direct proof of the action of Natural Selection is at present wanting,"[4]

and in 1932, Hugh B. Cott still has to admit with regard to the selectionist explanation of 'protective adaptations', "The hypothesis is of a sort which is incapable of proof."[5]

Darwin's great service was in pointing out the apparent probability of evolution, and we should not be considered as failing in respect if we doubt that he formulated a satisfactory explanation of the process. It would have been miraculous if Darwin had been able to anticipate the developments of more than a half-century of the most intensive biological investigation the world has seen. Hence we should not be surprised that all of the main points in his theory to explain evolution, namely, (1) the severity of the struggle between organisms for existence, (2) the preservation of individuals possessing slight favourable variations, (3) the inheritance of these variations, and (4) the similarity of natural to artificial selection, in the light of present day information must all be radically challenged.

I hope sometime to assemble and publish the notes on these matters that I have been making for years. For the present I would remind supporters of selectionist doctrine regarding protective adaptations that they are only bolstering a single pillar of a structure, the whole of which is adjudged by many biologists as doomed to collapse.

W. L. McATEE.

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[1] NATURE, 130, 202, 693; 1932.
[2] Smiths. Misc. Coll., vol. 85, No. 7, 201 pp., March 1932.
[3] Bequaert, J., "The Predacious Enemies of Ants", *Bull. Amer. Mus. Nat. Hist.*, 45, 271–331; 1922; in addition to my paper, pp. 92–97.
[4] *Nat. Sci.*, Vol. 5, p. 177.
[5] *Proc. Zool. Soc. Lond.*, Pt. II, p. 492; 1932.

IN his review in NATURE[1] of a publication by W. L. McAtee, entitled "Effectiveness in Nature of the so-called Protective Adaptations in the Animal Kingdom"[2], "B.P.U." apparently expresses agreement with that author in interpreting what he believes to be 'proportional predation' as evidence of indiscrimination in the choice of food by birds and other predatory animals. Mr. A. J. Nicholson has pointed out that the examination of birds' stomach contents, by itself, can give no evidence of proportional predation.[3] There is, however, another aspect of the subject to which I would direct attention.

Even were it demonstrated, as McAtee claims, that birds prey upon animals approximately in proportion to their numbers, it is difficult to follow him when he says "This means that. . . . predation takes place much the same as if there were no such thing as protective adaptations". McAtee's figures have reference to the various groups of food-animals eaten by "a wide range of species of all the families of birds occurring in the region". The food of these is considered collectively, and herein lies the fallacy in his argument.

This collective treatment of data takes no account of discrimination in the choice of food by *species*. I am not aware that any exponent of the selection theory claims for 'protected' animals immunity from attack. Every zoologist knows that specially defended insects suffer predatory assault. For example, ants have hosts of enemies, including many forms which eat practically no other food, such as Agamid lizards, some tree frogs and toads, woodpeckers, tamanduas and pangolins, besides numerous more casual predatory forms. Whether these so-called 'protected' insects are preyed upon in proportion to their numbers is still open to question. But the real point at issue is to determine whether this proportion—whatever it may be—would remain unaltered in the absence of the adaptations the effectiveness of which McAtee attempts to disprove. In other words, are these adaptations effective against *some* enemies? To this question McAtee's figures provide no answer.

The best method of approaching the problem is by the comparative examination of the stomach contents of predatory forms living in the same habitat, where the same food is available for different species. Viewed in this light, marked differences are observed in the food of different species in relation to that actually available: and selective discrimination, so vigorously denied by McAtee, is found to be the rule rather than the exception.

In NATURE of November 5, Mr. B. P. Uvarov[4] pays me the compliment of referring to a paper of mine, in which he states I have found "that ants constitute more than 90 per cent of the food of frogs". This statement refers accurately to four of the seven species of tree frogs examined by me. In this paper[5] is presented a considerable body of evidence of discrimination in the choice of insect food by tree frogs. In a more recent detailed investigation of the food of British batrachians I find strong evidence in support of this view. This is not the place to go into details which it is hoped will be published later. But it is pertinent to mention here that in a collection of frogs and toads taken both in the same habitat and under uniform conditions, the stomach contents of the two species differ markedly. Thus in 17 frogs and 45 toads collected on the heath-land association of Land's End during the past summer, the following striking differences in food animals were noted:

Food	*Rana temporaria* (per cent)	*Bufo vulgaris* (per cent)
Mollusca ..	24·8	0·6
Lepidoptera ..	13·4	2·4
Diptera ..	9·1	0·9
Formicidæ ..	0·4	41·4

These figures do not look like 'proportional predation'. Rather do they illustrate how a comparative study of predatory habits in insectivorous animals points to selective discrimination in the choice of food.

HUGH B. COTT.

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Nov. 29.—It remains for me to add that the above was written before the Editor let me see a proof of Mr. McAtee's reply to his critics. Considerations of space forbid comment here upon more than one point raised in his present letter.

With reference to the protective adaptations of ants, I would add to the data given above that in a careful examination of the alimentary tracts of 238 frogs and toads (collected between June 7 and October 30 in different habitats in Cornwall, Gloucester and Sussex, and at almost every hour of the day and night), the analysis of some 9,000 food-animals works out in reference to ants as follows:

4,103 ants were recovered from 126 out of 148 toads examined:

7 ants were recovered from 6 out of 90 frogs examined.

In the face of facts such as these, Mr. McAtee would do well to reconsider his sweeping assertion that "Ants are not rejected either relatively or absolutely by any potential predators".

HUGH B. COTT.

[1] 'B.P.U.', NATURE, 130, 66, July 9, 1932.
[2] McAtee, Smithsonian Miscellaneous Collections, 85, 7; 1932.
[3] Nicholson, NATURE, 130, 696, Nov. 5, 1932.
[4] Uvarov, NATURE, 130, 696, Nov., 1932.
[5] Cott, *Proc. Zool. Soc. Lond.*, 471; 1932.

The New Infra-Red Band System of the CO Molecule

THE transition of the CO molecule from the upper electronic state of the Hopfield-Birge absorption bands to the upper level of the Cameron bands, gives rise to a system of bands degraded towards the red, and extending from the infra-red region to about λ5660 A. These new bands, as they were called, were photographed by Asundi,[1] who also gave their gross vibrational analysis. On Asundi's plates the bands showed a diffuse multiplet structure. Measurements were made only on the first and the last heads.

It does not seem to be generally known, however, that McLennan, Smith and Peters[2] previously recorded the same bands as a series of triplets, using different conditions of excitation. The wave numbers of the first and the third head in each of the triplets agree closely with those of Asundi's, and in addition, measurements on the second head are also available. Making use of the equation given by Estey[3] for the new bands, McLennan's results fit in well in the expression:

$$V = \begin{matrix} 9325 \\ (9284) \\ 9233 \end{matrix} + (1173n' - 9n'^2) - (1726{\cdot}5n'' - 14{\cdot}4n''^2)$$

The value (9284) in the above equation, for the electronic energy of the second band-head, is obtained from the triplet separations as observed by McLennan.

In addition to all the transitions recorded by Asundi, those corresponding with (9, 2) (10, 2) (11, 2) (10, 3) and (11, 4) are to be noticed in McLennan's data, but transitions (2, 0) and (4, 1) are missing.

Johnson[4] and Asundi[5] put forward the view that the final level of these bands which is the same as the third positive and the associated bands is a quintet level, while Birge[6] and Mulliken[7] hold that it is a triplet one. It is of interest therefore to note that in the light of McLennan's results, the level appears to be a triplet one, unless some bands too faint for observation were missed. The unweighted mean of the triplet separations in the direction of the degradation of the bands is 37 and 46.

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Nov. 3.

[1] *Proc. Roy. Soc.*, 124, 277; 1929.
[2] *Trans. Roy. Soc. Canada*, 19, 89; 1925. Also, "Tables Annuelles Internationales de Constantes", vol. 7, Pt. 1, p. 697; 1930.
[3] *Phys. Rev.*, 35, 309; 1930.
[4] *Trans. Faraday Soc.*, 25, 649; 1929.
[5] *Loc. cit.*
[6] *Phys. Rev.*, 28, 1157; 1926.
[7] *Rev. Modern Phys.*, 4, 53; 1932.

Absorption Spectra of Metallic Colloidal Solutions, and Emission and Absorption of Metallic Films

Absorption of solutions and films. The absorption curve of films of silver has been recently published by Mohler[1]; and we have recently published the absorption curves of colloidal solutions of silver and gold.[2] The absorption curves of the colloidal solutions of silver and of the films of this element are almost exactly coincident, as may be seen on Fig. 1, where the axis of the ordinates for curve I (solutions of colloidal silver) shows the values of log $I/I_1 = \alpha d$, and for curve II (silver film at a temperature of 300° K) the values of log $J/J_0 = (4\pi nkx/\lambda)$ log e. The agreement between these curves confirms Mie's theory[3] that metallic colloidal particles have the same

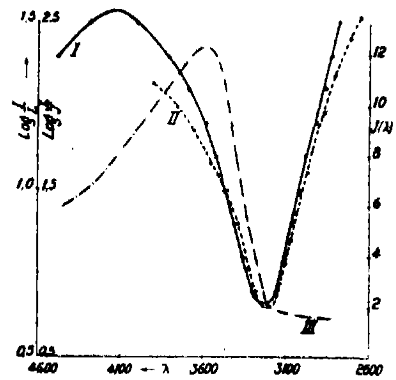

FIG. 1.

optical properties as a macroscopic mirror of the same substances.

Emission and absorption of the films. The films of tungsten, aluminium, beryllium, gold-calcium alloy, thorium and platinum bombarded with 7 volt electrons emit, according to Möhler and Beckner,[4] radiations similar in their intensity and in its distribution; the distribution of the spectral energy is constant between 6,400 A. and 2,400 A. Exceptions to this characteristic property are offered by copper,

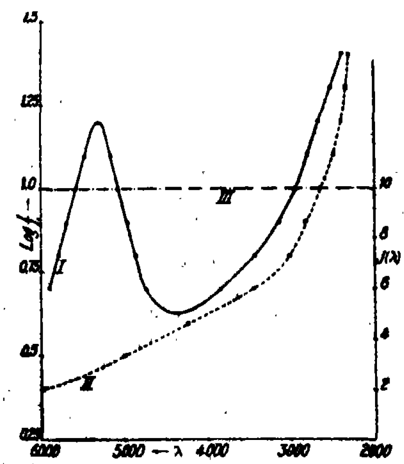

FIG. 2.

which shows a marked increase of emission in the red, and silver, which emits strongly between 3,600 A. and 3,200 A., the maximum emission being at this latter wave-length (Fig. 1, Curve III), which is near the maximum of absorption. In this instance there appears to be a relation between the maxima of emission and absorption. On the other hand, in the case of colloidal solutions of gold, there is no relation between the maxima of absorption and the spectra of emission of the films bombarded with electrons. In Fig. 2, curve I represents the absorption of colloidal solutions of gold (Bredig method), curve II

the same property for colloidal solution of gold (chemical method), and curve III is the emission of a gold film.

It would be of interest to determine whether the absorption curves of a metallic film are always identical with the absorption curves of the colloidal solutions of the same metal, as they are in the case of silver, with the view of ascertaining if Mie's theory is applicable to all metallic colloidal solutions; and also whether there is a correspondence between the characteristics of emission of the metallic films and their absorption, as happens in the case of silver.

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R. Argentina.
Oct. 20.

[1] *J. Research*, **8**, 357; 1932.
[2] *J. Chem. Phys.*, **29**, 117; 1932.
[3] *Ann. Phys.* (4), **25**, 377; 1908.
[4] *J. Research*, **7**, 751; 1931.

Neutronic Equilibrium of Isotopes

IF the formation or disintegration under astronomical conditions of the chemical elements, including the light ones, is considered as going on continuously, it is obvious that for each kind of atom there must be present its parent and its succeeding element. It can be proved, however, that the emission of α-, β- or even H·-particles by disintegration, or the entry of the α-, H·-particles or the electrons into the nuclei, is unable to explain the existence of every isotope. For example, it is impossible to explain in this way the formation of Sc^{45} by decomposition of Ti^{46}, Ti^{50} and V^{51}, or by emission of an electron from Ca^{44}. Likewise it is impossible to explain the formation of Ti^{50} by means of the entry of α-, H·- or β-particles into the nuclei of any one known atom. The same phenomenon is found in many other cases among the non-radioactive elements. The same negative results are obtained by supposing that one atom decomposes into two other atoms, or that the two nuclei form a new atom. The existence of every kind of atom and of all isotopes can be explained without difficulty, however, by supposing that the atoms of different elements can emit or incorporate neutrons (Nr)—even under astronomical conditions.

$$O^{18} \rightleftarrows Nr + O^{17}$$
$$O^{17} \rightleftarrows Nr + O^{16}$$

This hypothesis leads to the conclusion that the concentration of each isotope depends on the velocity of formation or decomposition of the heavier isotope. The neutronic equilibrium among all the isotopes of one element was probably established in astronomical conditions of formation of elements. This equilibrium exists at the present time, however, although the non-radioactive elements are decomposed with extremely small velocity or never decompose.

The calculations carried out by the use of Aston's table of isotopes show that the emission of a neutron by an element is connected with a loss of mass equal to 0·9997 (average value for 18 isotopes). If we accept the data given by Chadwick for the mass of a neutron, its emission involves the introduction of a considerable amount of energy. If, however, the mass of a neutron is less than unity, this process is an exothermal phenomenon.

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Time Determination

IN NATURE of October 29 appeared a letter on the above subject from Dr. de Graaf Hunter. A consideration of the geodetic literature of the last few years seems to indicate that he is a little pessimistic in his estimate of the errors likely to creep into longitude determination through the imperfect elimination of 'personal equation' by the modern transit micrometer.

Be that as it may, Dr. Hunter's proposed method of transit observation has much to recommend it. The general tendency in precise measurement, especially where it involves time as a measured quantity, is to make the whole thing automatic. This tendency needs to be combated or adopted guardedly because increased mechanism is undesirable in itself and because it frequently leads to unsuspected systematic error. For example, having occasion to use the rhythmic time signals both from Nauen and Rugby in connexion with gravity pendulum work, I found a systematic difference of 0·02 seconds in the estimation of this 2·1 hour interval by two observatories where good time-keeping is done. This means that the reaction of any automatic receiver to wireless signals depends upon some quality, possibly strength only, in the signals.

It will be noticed that Dr. Hunter eliminates one train of mechanism—the electrical contacts, the electro-magnetic pen and the chronograph—but inserts another and simpler mechanism—the electromagnetic shutter near the focal plane of the transit instrument. To this extent I think his method leaves something to be desired. The progressive flashing of the star in the field of view renders the observation almost precisely the same as that of the visual timing of a gravity pendulum. As a result of experience with the latter I formed the opinion that the electromechanical link in the chain—the so-called flash-box—was a weak one. In order to eliminate this link a chronometer (a Kullberg Mean Time instrument) was adapted to give direct flashes without the intervention of any electric current and without interfering in any way with its mechanism. A small plane metallic mirror was attached rigidly to the balance-wheel, which was then re-balanced in such a way as to give once more the excellent time-keeping for which the instrument had previously been noted. Although this arrangement gives four flashes per second, its use with an oscillator not differing in period by more than about one per cent from *n* times that of the wheel is found to be quite manageable. Further, the accuracy with which a single reading of a flash can be made lies between 0·001 second and 0·003 second, a figure which puts it out of court altogether as a possible source of error in determining the time of swing of the pendulum.

How, then, is it possible to preserve the spirit, so to speak, of Dr. Hunter's method of transit observation and yet do away with his mechanical shutter? Doubtless thinking on the same lines as he, I suggested in a report on longitudes to the meeting of the International Geodetic Union at Stockholm in August 1930 that if it were possible to communicate to the star image a small vertical oscillation the determination of time would be made with great accuracy by the unaided eye. The difficult judgment of *when* the image crossed a line would be replaced by the incomparably easier judgment of *where* it crossed.

As shown above, the comparison of the auxiliary

oscillator implied in this scheme with a chronometer or clock would be carried out to great accuracy with purely optical arrangements.

The practical details of my scheme present great difficulties but, surely, not insuperable ones.

Finally, I may add that the free gravity pendulum, which is the best time-keeper known over a few hours, has already been used on occasion to check the clock or chronometer during a longitude determination. Astronomers now prefer to place reliance on time-keepers rather than on star-places in determining the difference of longitude between two places.

H. L. P. JOLLY.

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Nov. 16.

Fourier Analysis and Vowel Curves

ATTEMPTS were made recently to apply the Fourier harmonic analysis to a collection of very large vowel curves traced off from a gramophone record through the courtesy of the Gramophone Company (His Master's Voice) of Hayes. One such wave in the actual size is reproduced in Fig. 1. The wave was first analysed by measuring 24 ordinates (12 harmonics). When a new curve was constructed from the results it showed scarcely the faintest resemblance to the original. The most important characteristics did not appear at all, and all the characteristics shown were erroneous. *Owing to the small vibrations, at least 200 ordinates* would have to be employed in order to produce any resemblance. This would require that number of schedules. At present the highest number for which schedules have been drawn up is 72 (published in my "Studies of Speech Curves", Carnegie Institution Publication No. 44). The work with 150 ordinates for a single wave would keep a person busy for several months.

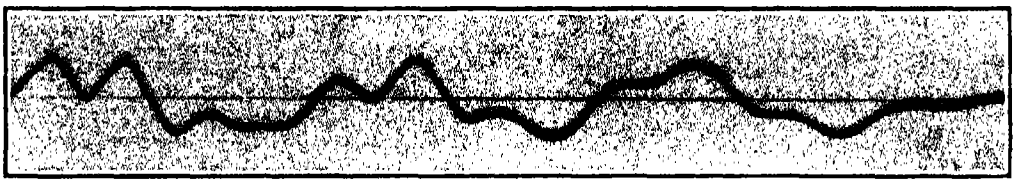

FIG. 1.—Part of a vowel curve traced from the words, "A day", from a phrase spoken by H.R.H. The Prince of Wales on November 11, 1927. Actual size.

Owing to the failure of measurements, the Mader harmonic analyser was then used. The point travelled over the curves and thus used every ordinate in producing the result. Even these curves were scarcely large enough to bring reliable results. The Henrici-Coradi harmonic analyser can be depended on to give reliable results when the wave is enlarged to 400 mm. horizontally. For large curves this would appear to be a satisfactory method except for one reason that will be stated later.

FIG. 2.—A few waves of the sound track of the vowel in a film record of 'hatch'.

Fig. 2 reproduces a few waves of the sound track of the vowel in a film record of 'hatch' made through the courtesy of R.C.A. Photophone Ltd., and Pathé, London. The curve shows fine details that cannot be brought out by a Fourier analysis on the basis of measurements with less than 500 measurements. Apart from the fact that schedules for such high numbers of ordinates do not exist, such an analysis of a single wave would probably require a year or so of calculation. Neither the Mader nor the Henrici-Coradi analyser can be used because the small waves are so steep that accurate readings cannot be made even in an enlargement. A decisive reason why no form of harmonic analysis can be used appears the moment *we observe that every vowel wave begins with a* strong upward jerk and fades away to almost nothing at the end just before the upward jerk of the next wave. The vowel wave is thus seen to have a strong decrement as one of its most important characteristics. A harmonic analysis does not provide for this decrement but uses it in giving false values to the assumed harmonic elements. A harmonic analysis of a decremental curve is necessarily erroneous. As pointed out previously[1] the curve of a vowel vibration represents a triple integration over the wave-length, the frequencies from zero to infinity and the *factors of decrement*. An analysis on this basis would give satisfactory results. A method for doing this does not yet exist. Any analysis that does not take the decrement into account gives erroneous results.

Another method of analysis[2] measures the apexes of the peaks and depths of the interior waves, and interprets the results as amplitudes of component harmonic sine waves. The method is superior to that of the Fourier analysis. It gives quite different results in that it provides for all frequencies and not the few harmonic ones. The method has been applied *with great success to larger non-decremental curves*, such as those of the number of travellers on a railway, drawings in a lottery, etc. It furnishes only erroneous results when applied to decremental curves and cannot be used for vowel analysis.

It is evident that an entirely new method must be found that shall satisfy the following conditions: It must provide for all frequencies between zero and infinity. It must provide for all factors of decrement that may be present. It must present its results in the form of numbers that have a useful meaning. It must not involve any assumption that the vibration is built up of simple sine movements. On the basis of sound tracks of the vowels, I am at present developing such a method and hope to have the result ready shortly.

The necessity for basing this and most other work concerning the physics of sound on sound tracks arises from the fact that the requirements of the film industry have produced a method of recording of very great accuracy. A comparison with the vowel

curves obtained by other means shows that they all lack the finer details that appear in the sound tracks and that all except a very few are so distorted that they can scarcely be said to be vowel curves at all. Of all the previously published vowel curves, only those obtained from gramophone records by myself and the Gramophone Company, those obtained by Miller with an oscillating mirror, those of Crandall with a special oscillograph, and those of Gemelli with a cathode ray oscillograph, resemble those in the sound tracks; even these lack the finest details.

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University of Vienna.

[1] NATURE, 130, 275, Aug. 20, 1932.
[2] Vercelli, "Analisi delle periodicità nei diagrammi (Cimanalisi)", *Att. Ist. Naz. Assicurazioni*, 3, 1; 1930.

Just Intonation

IF the tones C and the seventh harmonic of $A\flat$ are sustained together in the ratio 5 : 7, the two chief resultant tones are $A\flat$ and $E\flat$, the four tones together giving the true form of the accord known as the German sixth, 2 : 3 : 5 : 7, expressed in cents by the numbers 814, 316, 1,200, 583.

Now if the highest of the four tones is raised 20*c.* to 603*c.*, and C remains, these two are as 12 : 17, and with their two resultant tones, A and the seventh harmonic of F, they form the accord 5 : 7 : 12 : 17, in cents 884, 267, 1,200, 603. This is the true form of the chord of the diminished seventh.

The difference of 20*c.* is one-fifth of an equal semitone.

The tenor part, moving from and back to C major on the notes 386, 316, 267, 204, 471, 386, divides the semitone $E\flat$–D in the enharmonic proportions proposed by Archytas, contemporary of Plato, as recorded and rejected by Ptolemy, namely:

$$\tfrac{36}{35} \times \tfrac{28}{27} = \tfrac{16}{15}, \text{ or } 49 + 63 = 112c.$$

The succession in the bass, meanwhile, is simply G, $A\flat$, A, G, G, C, that is, 702, 814, 884, 702 and 0 (1,200)*c*.

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Nov. 29.

Distribution of Molybdenum

A VERY few elements constitute all save a minute fraction of the material of which plants and animals are made; but the small residuum contains a considerable, even a large, number of elements, stored up and accumulated by the organism and so present in larger amount than in the surrounding medium. We all know that iodine, for example, is abundant in seaweeds though the amount present in sea-water is very small indeed; and molybdenum is another element in much the same case. M. Eugène Cornec, several years ago, demonstrated the spectrum of molybdenum and of no less than seventeen other metals besides in the ash of seaweeds; and now I have succeeded in separating and estimating the molybdenum present in various plants and animals.

I happened to be analysing a certain coal-ash, and found traces in it of a metal the sulphide of which was soluble in sodium sulphide; by working on large quantities I was able to isolate enough of this metal for identification, and it proved to be molybdenum. One kilogram of coal was found to contain 0·21 mgm. of the metal, or 21 parts in a hundred million. I then began to look for molybdenum in all sorts of plants and vegetable products, and always found it, though the quantities were always small. The largest amount was found in beans and peas, namely, 3 to 9 mgm. per kilo; cereals come next in order, with 0·2 to 0·6 mgm.; while wood, leaves, and various fruits and vegetables contain only minute traces—cucumbers, for example, with 0·01 mgm. per kilo. Demarçay[1] had already demonstrated molybdenum in wood-ash, spectroscopically; my own method is a colorimetric one, based on the orange colour exhibited when a sulphomolybdate is heated in solution with ammonium chloride.

Ordinary plants must draw their supply of molybdenum from the earth, and accordingly I began to search for this element in various samples of soil; in a fertile soil I found from 0·1 to 0·3 mgm., on a moor I found 0·01, and on a barren sandy waste only 0·005 mgm. per kilo. I next analysed a number of mineral waters; but the only one (out of nineteen different samples) which contained an appreciable amount of molybdenum was the Source Perrière of La Bourboule, which contained 0·13 mgm. per litre. Mineral oils were found to contain molybdenum, sometimes in large quantity; the least amount was found in Persian crude oil, namely, 0·013 mgm., the largest in Mexican crude, which yielded no less than 5·55 mgm. per kilo. I then proceeded to look for molybdenum in the tissues of man and animals. The largest amounts I found in liver, and in the milt: for example, 1·5 mgm. per kilo, in the liver of ox or pig; while much smaller quantities, from 0·14 to 0·03 mgm. per kilo were to be found in blood, bile, milk, eggs and sundry tissues. Cod's liver contained 0·12 mgm. while haddock (whole fish) contained 0·03 mgm. per kilo; but in contrast to this I was unable even to detect molybdenum in a sample of forty litres of sea-water.

A relatively large quantity of molybdenum is contained in *Azolla*, a little aquatic plant which has become very abundant on the smaller canals in the neighbourhood of Delft. 264 gm. of the dried plant gave 0·298 mgm. of molybdenum, or 1·13 mgm. per kilo; and another sample, of 226 gm., gave 1·12 mgm. per kilo. On the other hand, the amount of molybdenum present in the canal water was very small indeed; it was necessary to operate on 23 litres before a titration could be made; and the amount obtained was only 0·021 mgm., or 0·0009 mgm. per litre. *Azolla* is remarkable for having a minute alga, *Anabæna Azollæ*, living in symbiosis in its tissues, and this alga is believed to be capable of fixing atmospheric nitrogen. Now H. Bortels[2] has made the interesting discovery that a certain microbe, *Azotobacter chroococcum*, which also possesses the power of fixing atmospheric nitrogen, is dependent for its healthy growth on the presence of molybdenum; and one begins to wonder what part the metal plays in *Azolla* and its symbiotic *Anabæna*. It has not been possible to separate these two symbiotic plants for purposes of analysis; and the amount of molybdenum which I have ascribed to *Azolla* is that of the two plants in their normal association.

H. TER MEULEN.

Delft.

[1] *C.R. Acad. Sci.*, 130, 91; 1900.
[2] *Arch. Mikrobiol.*, 1, 333; 1930.

General Transformation Theory in Hilbertian Space

ONE can write the Dirac's wave equation

$$\left\{\alpha_1 p_1 + \alpha_2 p_2 + \alpha_3 p_3 + \alpha_4 mc\right\} \psi = \lambda \psi \qquad (1)$$

in the matrix representation

$$\sum_{\sigma,\kappa} \left\{(\alpha_1)_{\tau\sigma}(p_1)_{\iota\kappa} + (\alpha_2)_{\tau\sigma}(p_2)_{\iota\kappa} + (\alpha_3)_{\tau\sigma}(p_3)_{\iota\kappa} + (\alpha_4)_{\tau\sigma} mc\right\} \psi_{\sigma\kappa} = \lambda \psi_{\tau\iota} \qquad (2)$$

which will be *invariant under any unitary transformation* of the Hilbertian spaces of spins and momenta ($(p_1)_{\iota\kappa}$ denote the components of the momentum matrix in the Hilbertian space).

Usually one considers only the Cartesian systems in Hilbertian space, but from a general point of view one is led to investigate the invariance of quantum laws under more general affine transformations. To assure this invariance one has to introduce the 'metric matrices' $\gamma^{\sigma\varrho}$ and $g^{\kappa\lambda}$ for the two Hilbertian spaces as new dynamical variables, and to write equation (2) as follows

$$\left\{(\alpha_1)_{\tau\sigma}\gamma^{\sigma\varrho}(p_1)_{\iota\kappa}g^{\kappa\lambda} + (\alpha_2)_{\tau\sigma}\gamma^{\sigma\varrho}(p_2)_{\iota\kappa}g^{\kappa\lambda} + (\alpha_3)_{\tau\sigma}\gamma^{\sigma\varrho}(p_3)_{\iota\kappa}g^{\kappa\lambda} + (\alpha_4)_{\tau\sigma}\gamma^{\sigma\varrho} mc\right\} \psi_{\varrho\lambda} = \lambda \psi_{\tau\iota} \qquad (3)$$

(where the covariant and the contravariant characters of the indices as usual are distinguished by their position).

To account for an external electromagnetic field, one usually introduces in the Dirac equation the potentials of the field, which causes a corresponding change in the eigenvalue spectrum of the equation. But if one starts from the general equation (3), one can always by an appropriate choice of the 'metric matrices' $\gamma^{\sigma\varrho}$ and $g^{\kappa\iota}$ ensure that this equation gets a given eigenvalue spectrum. This follows from the well known fact that by a simultaneous non-unitary transformation any two quadratic forms $H_{\iota\kappa}$ and $G_{\iota\kappa}$ may be transformed into diagonal forms, one of them becoming the unit form. We can thus formulate the principle of general transformation as follows:

It is impossible to distinguish between a set of states described by a Dirac equation for a free particle in a non-unitarian Hilbertian space and a corresponding set of states, described by the usual Dirac equation in a given external field.

Thus the electromagnetic field appears to be an expression of the non-unitary metric in the Hilbertian space in the same way that the gravitational field is an expression of the non-Euclidian metric of the space-time world.

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Room Comfort

IN a note in NATURE of Nov. 12, p. 743, reference was made to the kata-thermometer as being considered too small for its purpose as an indicator of comfortable conditions in a room, and to the larger electrically controlled instrument, the eupatheoscope, described by Mr. A. F. Dufton, the surface of which is automatically kept at 75° C., a temperature corresponding to that of the clothed surface of the body in ordinary room conditions. This instrument was considered more suitable owing to its size.

The kata-thermometer does not indicate the rate of cooling of the body but of the bulb of the thermometer, which approximately is at the temperature of the skin of the face. The range of cooling powers which are best for comfort were fixed empirically in conditions which were admittedly fresh and pleasant. Like the skin of the face, the kata-thermometer is very sensitive to the cooling effect of wind.

I have shown that the infra-red rays from dull red and dark sources of heat produce uncomfortable sensations in many people. They tend reflexly to congest the nose and make it stuffy, the congestion lessening the nasal air-way. These effects are set aside by cool air, for example, by a fan blowing on the face. As the kata-thermometer is very sensitive to cool warming air, it is an excellent indicator of those conditions which give a fresh feeling. The mere securing of a certain cooling power and temperature of the clothed surface is not sufficient to give comfort, and as the small size of the kata-thermometer is actually an advantage, its utility is not surpassed by that of the eupatheoscope.

LEONARD HILL.

Chalfont St. Peter.
Dec. 10.

Colour-blind Motorists and Red Danger Signs

IT is not, I think, realised what a menace the colour-blind have become under present conditions; their contribution to the toll of the roads, for example, is never even mentioned. Most colour-blind persons are blissfully unaware of their abnormality and in Great Britain there are probably one hundred thousand colour-blind persons licensed to drive motor vehicles. Would-be drivers of railway trains are tested as a matter of course and some four per cent are rejected for defects in colour-vision, but no tests are imposed upon those who use the roads.

The peril of the roads is enhanced by our use of red as the sign of danger—the one colour which the ordinary colour-blind person cannot see at all—and it is instructive to don a pair of blue spectacles (copper glass) and to learn how the world appears to a daltonian. The danger is greatest, of course, at night, when the red rear-lights of vehicles, road obstruction lamps, reflectors on bicycles and *beacons* at cross-roads are well-nigh invisible and fail to convey any warning. Automatic light-signals which show red as a stop-sign may be a source of danger by day as well as by night.

As colour-blindness is largely congenital, it will doubtless soon be practicable to eliminate it. In the meantime all 'bus drivers should be tested (on November 5 one did not see my brilliant red rear-light and charged into the tail of my car), and coroners might well inquire into the colour-vision of those who at night drive down inoffensive cyclists.

A. F. DUFTON.

Greenbank,
Garston, Hertfordshire.
Dec. 1.

Systems of Four Immiscible Liquid Layers

THE mixture described by E. Lester Smith[1] gives a system which separates into four layers, as stated, but does not appear to be stable. A specimen made up as described at first separated into four layers, but after long standing these become two layers. One sample of the system made up in January 1931 has now formed two layers, coloured brown, and separates into these two layers on standing after agitation. The phase rule deals with systems in true equilibrium.

J. R. PARTINGTON.

East London College, E.1.

[1] NATURE, 127, 91, Jan. 17, 1931.

Research Items

Ancient Civilisation in the Rift Valley.—Capt. G. E. H. Wilson discusses in *Man* for November the evidence for the existence of a forgotten civilisation in the Rift Valley, East Africa. The existence of ancient works, terracing, graded roads (the so-called elephant tracks) and irrigation works—canals and drainage—is now established not only in Tanganyika, but also in Abyssinia, Uganda, Kenya and Northern Rhodesia. The terraces, averaging in width at the top about one foot, but probably originally about three feet, follow the contours of the hills. The depth between terraces is about three feet. The roads, clearly not elephant tracks, point to a high state of civilisation. They are difficult to locate, though in places they are part of roads in use to-day. The points at present located suggest a system of communication running north and south on the eastern side of the Great Lakes, pointing to outlets by way of the Nile in the north and by Rhapta in the south, with possibly an intermediate route via Mombasa, the origin of which may prove very much more ancient than is thought. There are traces of an extensive system of irrigation at Uhehe, and in low-lying districts, such as the Mgeta River near Kisaki, there are river diversions which may be artificial. As to the authors of this civilisation, there are legends of an alien race dominating local peoples in both north and south Tanganyika. At present there is a great diversity of language and culture where those ancient works are found; but at some time the people may have been more homogeneous. If there has been an alien immigration, it is possible that it may have taken place so early as 1500 B.C., and that by the time of Solomon (970 B.C.) a flourishing trade already existed and the Sheban port of Rhapta had been established. It is suggested that this ancient civilisation may have originated in the north, spread through the Rift Valley over the highlands of the Great Lakes, and have reached Zimbabwe.

Sociological Value of Churches.—The problem of "The Churches and Social Well-being" is discussed by John Miner in *Human Biology*, September, 1932. An attempt is made to find some statistical evidence in the United States in support of the popular assumption that churches are not only the bulwarks of morality and social stability, but also promote social well-being in general. Correlations were calculated between the percentage of church members in each State and indices of wealth, education, health, and sexual morality. So far as his evidence goes, Miner finds no indication of any effective contribution of the churches to social well-being. States with large proportions of church members are on the average no healthier, no wealthier and no more literate than States in which the churches are weak, and show no lower illegitimate birth rates or death rates from venereal diseases. States with large proportions of Methodists and Baptists appear to be relatively poor and illiterate.

'Legislative Anthropology' in the United States.—Dr. Arthur Macdonald, who is well known for his advocacy of the study by anthropometric measurement of the members of legislatures as a body, as best representing the anthropological status of the population of their respective countries, has recently published in the *Congressional Record*, Washington, D.C. (Seventy-seventh Congress, First Session) an anthropological study of eighty-nine congressmen, representing various States, who may be taken as typical of the successful American in the prime of life. The great majority of them are of English or Scottish ancestry, while the remainder have a good sprinkling of English or Scottish blood. Their average age is fifty-three years. The average length of head is 196 mm., breadth, 156 mm. and height, 139 mm., cranial capacity, 1,625 c.c., and estimated weight of brain (Welcker's formula), 1,543 gm. Some interesting results emerge from a classification in State groups. The western south Central States (Arkansas, Louisiana, Oklahoma and Texas) give the greatest stature, 179 cm., greatest brain weight, 1,571 gm., and longest head, 198 cm.; the western north Central States coming next with brain weight 1,525 gm. and stature 177 cm. The lowest brain weight comes from the Pacific States (Washington, Oregon and California), of which the five members measured have a brain weight of 1,419 gm., head length, 191 mm. On the other hand, these five members have the greatest strength of hand-grasp—76 kgm.

Host-Parasite Relationship in *Olpidium*.—*Olpidium viciæ* and *O. trifolii*, which are found in the field only on *Vicia unijuga* and *Trifolium repens* respectively, are shown (S. Kusano, *J. Coll. Agric. Imp. Univ. Tokyo*, vol. 11, No. 4, 1932) by inoculation experiments to develop in sixty-three out of eighty-one species (sixteen out of twenty families) of phanerogams inoculated. The host plants react in two ways to the attack of the fungus. In one group the formation of a tumour results, while in the other no sign of infection is recognisable externally. The host of this second type may function as the fungus carrier, being susceptible to the parasite but immune from the disease. The hosts reacting in the first manner to *O. viciæ*, namely *Vicia unijuga*, *V. faba* and *Pisum sativum*, react to *O. trifolii* in the second manner; reciprocally the plant reacting in the first manner to *O. trifolii* exhibits the second type to *O. viciæ*. All parenchymatous tissues from the various plants liable to infection induce an apparent positive chemotaxis to the swarm cells of the fungus and the potassium ion is the active agent in this chemotaxis. Many susceptible plants remain unaffected in Nature because their anatomical characters, growth forms or habits prevent the parasite from approaching their susceptible cells. The morphological difference between the two forms of *Olpidium* is exceedingly slight and the range of their hosts exactly coincides. There is, however, a clear distinction between them as regards their effect upon certain plants.

Physiology of Ciliary Movement.—The first of a series of papers on this subject dealing with the effect of hydrogen ion concentration upon the ciliary movement of the gill of *Pecten* has recently been published by Dr. Shichiroku Nomura (*Sci. Rep. Tôhoku Imp. Univ.*, fourth ser., vol. 7, 1932). The most important conclusion reached, which appears to be based on sound experimental evidence, is that stoppage of the cilia in an enclosed chamber is not due to accumulation of carbon dioxide, as previously supposed, but to lack of oxygen. The supposed effect of carbon dioxide in regulating the rate of respiration in lamellibranchs by depressing ciliary activity is thus untenable, at any rate for the species examined.

Interesting figures are also given of the critical pH values for the stoppage of cilia by carbonic, acetic, phosphoric and hydrochloric acids, which range from 5·5 to 3·8 in the order given. The longer the period for which the gill was exposed to acid sea-water, the longer it took to recover. This result is not in agreement with Gray's work on *Mytilus* but this animal, unlike *Pecten*, is a member of the littoral fauna and is normally uncovered daily and the gills exposed to a low hydrogen ion concentration in the mantle cavity. After the gill cilia had been stopped by lack of oxygen, motility was recovered by re-admittance of oxygen even after the gill had been left overnight.

Determination of Sex.—Max Hartmann discusses some very interesting work on the determination of sex in *Die Naturwissenschaften* for July 29, 1932. In the higher animals and plants, the two kinds of sexual cells are readily distinguished, but passing to the simpler organisms, such as the Algæ and Fungi, forms exist in which the differences in form may be very slight and the two gametes are practically only distinguished by their behaviour—the type regarded as male, or so-called – (when no form difference is recognisable), usually being more active than the female or +. In the extreme case, even this physiological difference disappears. The school of workers under Hartmann at Berlin, working mainly on Algæ, have devised a good method by which they have shown that even in the extreme isogamous forms, a sharp distinction of the gametes into two kinds exists, which is expressed by the liberation into the culture solution of an actual sex-specific substance. If the filtrate from a + culture which contains bacteria, is added to a culture of the – type, a grouping of the gametes is induced, as when gametes of the + and – types are mixed, though actual fusion does not occur in the present case. The explanation given is that the bacteria in the one culture have absorbed a substance, which affects the behaviour of the gametes in the other culture in the same way as the presence of the actual gametes would have done. The gametes, though morphologically and physiologically similar, yet exude distinct substances according to whether they are + or – and only gametes of these opposite kinds will copulate.

Meteorological Observations in Southern India.—In a paper on the extreme dryness observed at Kodaikanal during the winter months, by S. L. Malurkar (*Scientific Notes, Ind. Meteorol. Dept.*, vol. 4, No. 43), an attempt is made to explain the occurrence at Kodaikanal of dry spells during which the relative humidity frequently falls below 10 per cent and attains at times values so low as probably to be far outside the range of accuracy of ordinary wet-bulb hygrometry. Kodaikanal is one of the hill-stations in southern India; it lies in lat. 10° 14′ N. and long. 77° 28′ E., at an elevation of 2,343 metres. Two common causes of exceptional dryness are the advection of air from high to low latitudes accompanied by a rise of temperature due to powerful solar radiation, and the gradual descent of air from high to low levels, such as takes place in many anticyclones, with consequent rise of temperature due to compression of the air as it comes under the higher pressure of the lower levels. In this paper the alternative explanations are critically examined in the case of Kodaikanal. An anticyclone is almost always to be found over southern India in winter, and incursions of dry cold air from northern India often take place round it, but on examining the observed humidities and temperatures over India at these times, no support is found for an explanation based on these. With the idea of descent of air from above, on the other hand, the observed course of events at Kodaikanal and other places fits well. There is often an inversion of temperature with a dry layer, and on plotting the relative humidity at Kodaikanal against the height of this layer as measured by registering balloons at Poona, it was found that the two were positively correlated; further, the occurrence of exceptional dryness was generally simultaneous at all stations with an elevation of 2,000 metres or more, and was apt to be absent from the stations at lower levels. These facts seem to leave little doubt that the exceptional state of the atmosphere is observed on those occasions when the inversion layer of the nearly permanent anticyclone is to be found at a lower level than usual.

Luminous Phenomena accompanying Earthquakes.—Shortly after the Idu earthquake of November 26, 1930, Mr. K. Musya collected many records of luminous phenomena observed at or about the time of the earthquake (NATURE, 128, 155; 1931). Since then, he has studied the phenomena attending four other earthquakes (*Earthq. Res. Inst. Bull.*, 10, 649–673; 1932). The most important of these is the South Hyuga earthquake, which occurred at 7.3 P.M. on November 2, 1931, the number of observations collected being 355. They were observed most frequently at the time of the earthquake and over a tract of country about 130 miles from north to south. The directions in which the lights appeared are varied, but most observers on the coast saw them towards the district in which the submarine epicentre lies. The luminescence usually seemed to radiate from the horizon or to be like a search-light turned to the sky, in colour most often blue or bluish. The phenomena were clearly not due to houses on fire, or to lightning or landslides, though some may be assigned to electric sparking or to meteors. But the author is convinced of the reality of the phenomena and of their connexion, in some way not at present understood, with the earthquake.

Charge of Thunder Clouds.—In the *Revue Scientifique* of September 10, C. Dauzère, director of the observatory at the Pic du Midi, discusses at some length the present position of our knowledge concerning the transfer of electricity from the clouds to the earth by rain drops and by lightning of the ordinary type. He gives summaries of the theories of Simpson and Wilson in regard to the polarity of thunder clouds, and of the two appears rather to favour Simpson's theory that the positive pole is in the lower parts of the front of the cloud and the negative pole in the rear and at the top of the cloud. According to a theory of his own, however, introduced in a number of papers published within the past five years, the ice particles of the cirrus clouds play a part in the distribution of electricity in the thunder cloud. This theory supposes that positive electrification of the ice particles caused by ultra-violet light leads to the condensation upon them of super-cooled water droplets carried upwards by the vertical currents in the cloud, and that the resulting hailstones have generally not had their positive charges neutralised by the time that they have become heavy enough to fall into the lower

forward parts of the cloud. M. Dauzère's view, therefore, is that the large positively charged drops normally found there, which are explained by Simpson as due to the mechanical break-up of drops exceeding a critical size, are partly derived from the cirrus level, and he regards the top of the cloud—or at least the overlying cirrus—as positively charged. But he considers all this part of the subject, and also the question as to whether positive or negative electricity is discharged by a lightning flash, as very speculative, that in fact there is only one point about which definite knowledge has been acquired since the time of Franklin, and that is in regard to the sign of the charge normally carried by raindrops; this charge has been found to be positive in widely separated parts of the world.

Nature of Martensite.—An interesting contribution to our knowledge of the nature of martensite is contained in a paper by Honda and Nishiyama (*Sci. Rep. Univ. Tôhoku*, series I, vol. 21, No. 3, 299). It has been known for some time that when a hardened steel is tempered, several physical properties show a sudden discontinuity at a temperature just above 100° C., as well as a more gradual change between 250° and 300° C. The meaning of the two sets of changes has hitherto been somewhat obscure, but it is now suggested that the first represents a transformation from the tetragonal form of martensite, which results directly from the quenching, to a cubic modification, whilst the latter is due to the breakdown of the cubic martensite to troostite. Since for both forms of martensite the size of the unit cube changes continuously with the carbon content of the steel, it is held that proof has been obtained that they are both solid solutions and not structures in which the carbide is present as particles of colloidal size out of solution. From measurements of the density it is shown in each case that the carbon atoms are arranged in the lattices interstitially and that the replacement theory is untenable.

Astronomical Topics

A Recent Sunspot and Magnetic Disturbance.—A large, single sunspot that was recently visible to the naked eye for a few days crossed the sun's disc between December 6 and 19. It was the return of the leader spot of a large group which had developed rapidly between November 16 and 21 and was then lost to observation around the sun's west limb. The position of the spot was, longitude 325°, latitude 10° north, and its area 600 millionths of the sun's hemisphere on December 7 and 450 millionths on December 14. The spot was most nearly in line with the earth on December 13·0, and on December 14 at 16^h a considerable magnetic disturbance began (in which the range in declination at Greenwich was nearly $\frac{1}{2}°$), thus strongly suggesting a connexion between the activity of this region of the sun and the earth's magnetism. Although the spot was observed with the spectrohelioscope at Greenwich, whenever the sky permitted, no activity in the nature of an eruption was seen in the light of Hα. The longest possible watch was limited, however, to two hours on December 12, so that combined observations from observatories abroad may be more decisive. It may be added that a sunspot of this size is rare but by no means unique during the epoch of minimum phase of the eleven-year cycle upon which the sun's activity has now entered.

New Comet, 1932*n*.—Mr. G. F. Dodwell, the Government Astronomer at Adelaide, has telegraphed to the Astronomer Royal announcing his discovery of a comet of magnitude 11. On December 17 at 1^h (probably local time, but telegraphed as U.T.), its R.A. was $23^h2^m23^s$, South Declination 28° 43′; the R.A. was increasing 3^m18^s daily, the declination diminishing 47′ daily, motion northward. Mr. Dodwell suggested identity with Tempel's comet, but this does not appear to be possible. The comet is on the meridian about 5 P.M.

The Leonid Meteors.—*Popular Astronomy* for December and Science Service, Washington, November 25, report that a fairly active shower was seen in the United States in the early hours of November 16.

At Dubuque, Iowa, the rate reached 240 per hour, and two bright meteors were seen after sunrise. At Yale Observatory it was noted that the proportion of bright meteors was large. Half of them were brighter than Procyon and one-fifth of them brighter than Sirius. At East Radford, Virginia, 734 were recorded in 3 hours; at Catskill Mountains, New York, 901 were recorded. The last two numbers, however, include many duplicates. At Harvard, Dr. P. H. Millman photographed the spectra of the trains of two bright meteors; the photographs had not been fully examined when the report went to press.

The above results suggest that the predicted time of maximum, Greenwich noon on November 16, was not greatly in error. Probably if the moon had been absent, this shower would have been considered a fairly good one.

Mass of the Galactic System.—Dr. J. H. Oort has investigated (*Bull. Astron. Instit. Netherlands*, vol. 6, No. 238) the force exerted by the galactic system in a direction perpendicular to its plane. His methods involve so many steps that they cannot be summarised within the limits of a note, which is therefore limited to his conclusions. The acceleration perpendicular to the plane increases proportionally to the distance from the plane up to a distance of 200 parsecs, and then remains nearly constant to a distance of 500 parsecs. The mass per cubic parsec in the sun's neighbourhood is 0·092 sun, but in the larger region including stars to 13·5 visual absolute magnitude it is only 0·038 sun; this would, however, be increased if still fainter stars were included. The mass of interstellar dust and gas is concluded to be only a small fraction of that of the stars. The mass per cubic parsec is shown to be of the same order as that deduced by Dr. Hubble for the Andromeda nebula. The nebula N.G.C. 4594 indicated greater mass in proportion to its light; but the light of this nebula is dimmed by a belt of absorbing matter.

A note at the end of the article gives reasons for believing that van Maanen's star has a mass 3 times the sun's, with a radius of 5,000 km.; the resulting Einstein shift to the red is 240 km./sec.; it is pointed out that it will be possible to distinguish this from true recession by measuring the change of proper motion in forty or fifty years.

Durban Meeting of the South African Association for the Advancement of Science

THE thirtieth annual meeting of the South African Association for the Advancement of Science was held in Durban on July 4–9, under the presidency of Prof. P. J. du Toit. The meeting was very well attended and 117 papers were read. The South African medal and grant were presented to Prof. J. W. Bews and the first British Association medal to Dr. Nellie F. Paterson at the close of the presidential address. Popular evening lectures were given by General J. C. Smuts on "Climate and Man in South Africa" and by Prof. B. de St. J. van der Riet on "Essential Oils". There was a reception by the mayor and councillors and numerous excursions to places of scientific interest in the neighbourhood. [The papers presented at the meeting are now available as vol. 29 of the *South African Journal of Science* (Johannesburg: South African Association for the Advancement of Science, 1932. 30*s*. net).]

The presidential address on "Africa's Debt to Science" was delivered by Prof. P. J. du Toit. To illustrate what science has done for Africa, advances in preventive medicine and in veterinary science were considered in detail. Progress in the science of nutrition, including the rôle of vitamins and minerals for man and stock, was summarised and the interrelation of botanical and veterinary science indicated. Improvements in refrigeration and in communication were noted. What science can do for Africa in the future was indicated as increase in health, reduction of infantile mortality, eradication of diseases such as malaria and East Coast fever, organisation of native races and the development of large white dominions in Africa. According to Prof. du Toit, Africa should do much more to further research. The best use is not being made of either the money or the men available. Economy in brain power is necessary and men of great research capacity should not be wasted doing the work of junior clerks. Research should not be sacrificed for economy. Organisation of research is necessary and also the creation of conditions such that outstanding men can devote themselves to research.

Prof. R. W. Varder gave an account of recent work on "Particles and Waves" as his presidential address to Section A. The quantum theory in relation to light and waves was discussed and the photoelectric and Compton effects were contrasted with de Broglie's views. The interference experiments of Thomson and their mathematical solutions, leading to the uncertainty principle of Heisenberg, were discussed. Quantum mechanics, radioactive decay and the structure of the atom in relation to modern spectral theory were also considered.

The presidential address to Section B, delivered by Dr. L. J. Krige, dealt with "The Geological History of Durban". After the deposition of the oldest existing South African rocks, included in the Swaziland and Pongola systems, intrusions of granite occurred. The earlier formations were afterwards denuded, and granite is the most ancient rock near Durban. Succeeding formations are not represented in Natal. Each of the old systems has a bed of tillite, indicative of arctic conditions, and the Dwyka ice age was the severest known. At the break-up of Gondwanaland the Cretaceous beds of Durban Bay were deposited. In the Pleistocene the Bluff Peninsula was built up and the sea level oscillated to 500 ft. In post-Pleistocene times, sea level did not rise so high as in previous inter-glacials, but at its greatest height a spit was built from the Bluff to the mouth of the Umgeni River, which opened into the original Durban Bay. Its silting up formed the Durban flat and resulted in its present course to the sea. Sea level subsidence left the old alluvial flats above sea level and several rivers formed new flats. Remains of marine wave-cut terraces occur between the Bluff and the Umbogintwini River and mark its former position.

Prof. E. M. Robinson considered "The Development of Veterinary Bacteriology in South Africa" in his presidential address to Section C. The early work on bacteriology here was noted, then special diseases were considered. The work on anthrax, including immunisation, attenuation and methods of administration were described. The gas gangrene group includes the organisms of blackquarter and the various methods of treatment were described. The usefulness of formolised vaccines against *B. welchii* and *B. œdematiens* was noted. The work on contagious abortion due to *B. abortus* and *Vibrio fœtus*, and the salmonelloses, of importance to the poultry industry, were discussed. Bovine tuberculosis is receiving attention; avian tuberculosis does not seem widespread. *C. parabotulinum bovis*, responsible for lamsiekte of cattle, was discussed and miscellaneous bacteriological conditions in domestic animals noted.

Dr. R. Broom spoke on "Evolution as the Palæontologist Sees It" in his presidential address to Section D. The hypotheses of Darwin and Lamarck were considered palæontologically. Evolution, said Dr. Broom, is not by large mutations but by almost imperceptibly slight modifications along definite lines, from small generalised forms to large highly specialised types, as is shown by a wealth of examples. The evolution of horns in fossil and modern forms was considered. Many structures that were useless developed in the past, and their owners were failures. Evolution is continuous, not backwards and forwards. About 99 per cent of all known fossil forms became specialised in some direction so that they could not adapt themselves and so perished. The Therocephalia remained small and generalised. By the middle of the Eocene all known mammalian orders were established, all small generalised types had specialised and hence no new orders of mammals could afterwards appear. The belief was expressed that a psychic and a cosmic force had been at work and that some force had restrained the specialisation of the primates, evolving a higher type of brain, and causing man to appear. As evolution has practically finished and cannot be repeated unless all higher life is wiped off the earth and a new start made, man may be the end to which some power has guided evolution.

The presidential address to Section E, by Miss D. F. Bleek, was entitled "A Survey of our Present Knowledge of Rockpaintings in South Africa". Four areas in southern Africa were delimited. The first comprises the western Cape Province, Cape Midlands and southern part of the eastern Cape Province. There are three subdivisions: the western, with pictures showing poor work, little grouping, few superpositions; the midland, with many group scenes, more superpositions and bichromes in the

latest layer; the south-eastern, less developed and mostly monochromes. The second area comprises the north-east Cape Province and foothills of the Drakensberg in Basutoland, the Free State and Natal. Caves are crowded with pictures, there are numerous superpositions, group scenes are frequent and monochromes, bichromes and polychromes are numerous. Towards the north, rock engravings replace paintings, the best being in the Transvaal. The third area, between the Kalahari and the Atlantic, has polychromes and dressed human figures of a curious type not found in areas 1 and 2. The fourth area, Southern Rhodesia, has granite as rock background, monochrome animals standing quietly, trees and plants and two types of human bodies; the workers seem to have been some branch of Bushmen. Southward migrations of different branches of the race seem to have occurred, one degenerating in art as it went, the other developing a high state of perfection.

The Rev. Prof. J. du Plessis dealt with "Missions as a Sociological Factor" in his presidential address to Section F. The influence of early missions, before the colonial era began in 1884, on the black races of Africa was considered. Before 1884, the influence of missions on the general social life of the African was in part destructive; witchcraft, poison ordeal, human sacrifice, etc., being banned. Hygiene, sanitation, clothing and housing, industry and agriculture were introduced. The educational methods of early days were open to criticism, since the English public school system was imposed on people to whom it was not applicable. Adoption of European methods of life and the social status given them by the missionaries alienated them from their people. The introduction of better food products and teaching of trades in the early days were commended. The missionary carried the gospel, but in his wake came the traders and the Government. These contacts meant change of the old social order, and the value of missions was that they enabled the native to make the transition from old to new without moral and social disaster. New culture must be grafted on the old stock of native life. Missions are still necessary as a permanent and not merely permissive factor in the evolution and uplift of the native races.

In Section A a paper was given on the determinantal properties of oblong matrices; astronomical papers dealt with the pulsation theory of Cepheid variation, Tempel's comet 1866 (1) of the Leonid meteors, and the parallax of Nova Persei, 1901. The definitions of mechanical quantities were discussed. A new type of continuously variable inductance of fixed resistance was described. A series of papers dealt with the Electricity Supply Commission, the cost of generating and distributing electricity and electrostatic capacity. Recent investigations on cosmic rays and on Wilson chamber experiments on δ-rays were described, and a note on polarised light-stress apparatus was presented. Mechanical strength of aggregates, soil erosion and its prevention, and veld reclamation were subjects of discussion.

In Section B there were several joint meetings with other sections. Papers of geological interest dealt with the problem of past climates and peculiar little rock basins at Isipingo, Natal. The essential oils of *Empleurum serratulum* and of certain veld bushes in the Cape Western Province were described, as was the chemistry of the roots of *Arctopus echinatus*, and a further contribution to knowledge of the medicinal springs of South Africa was made.

In Section C a number of papers of mycological interest dealt with *Helminthosporium* parasites of cereals and wild grasses, the genus *Hemileia*, of importance to coffee growers, aster wilt, South African Clavariæ, various new South African fungi, die-back in *Pinus insignis* and a fungal infection on a tsetse fly. Bacteriological papers were concerned with the Weil-Felix reaction in heartwater, the serological diagnosis of horse sickness and the distribution of *Azotobacter* in Transvaal soils. An ecological study of the wattle bagworm, involving the possibility of controlling the insect by salting the soil, was presented, while another paper dealt with the physico-chemical changes produced in soils by the addition of salt. A series of papers of much interest to agriculturists related to work on intensive grazing on veld, experiments with improved pastures in the coastal belt, the relation of fertiliser treatment to soil reaction under turf, a pasture study of grazing conditions on a Potgietersrust farm, and a regrouping of cultivated barleys, with suggestions on the classification of cultivated plants. A revision of the genus *Lopholæna* was given. Other papers dealt with the cytology of the pollen mother-cells of certain plants, the aims and requirements of the International Committee on plant sociology and phytopathological notes.

In Section D papers of much entomological interest dealt with the embryological development of *Euryope terminalis*, the early stages of some South African hesperids, the biocœnosis of the plant *Gnidia laxa*, the possibilities of combating wattle bagworm with insecticidal dusts, and the control of *Glossina pallidipes*. Embryological papers dealt with developmental stages in the skulls of geckos and the morphology of the skull of *Hyperolius*. Papers on the morphology and phylogenesis of the Pareiasauridæ were of interest to palæontologists. Protozoological papers dealt with new parasitic Protozoa, including new species of *Isospora* and *Eimeria* from snakes and fish, with the freshwater Rhizopoda from the Worcester District of the Cape, with new species of *Nebela* found in South Africa and with the rate of growth of gregarines. *Testudo verreauxi* was discussed as a study in variation. The ultra-violet content of South African sunlight and the effect of underground work on the erythrocyte count of miners were considered. The validity of the Polypedatidæ as an autonomous family of the Anura was considered from the detailed anatomy of a number of genera. The significance of seasonal egg production in predicting the yearly total was of much interest to farmers. Baboon crania from Cathkin Peak district were described. South African Ancylidæ and the occurrence of schistosomiasis at river mouths were discussed. Two papers of much interest and causing much discussion were given in joint meetings with other sections and dealt with biology in relation to modern civilisation and with glands in relation to personality.

Section E had papers mainly centring round prehistory and social anthropology. The prehistory of South Africa and western Europe, the Smithfield and Wilton industries, and the archæology of the Cathkin Peak district were discussed. Rock shelters and archæological sites at Isipofu near Durban and at Salisbury Commonage were described, and papers were given on prehistoric South African defences and the ancient forts at Penhalonga, Southern Rhodesia. Strandlooper middens and implements in Natal were described, the occurrence of true burins in the Cape Province was notified, and an account given of the South African cleaver or biseau. The origin and

phallic character of conical and perforated stones were discussed. Some South African Bushman paintings and rock engravings were described, and the weathering of granite in relation to such paintings was considered. The Bantu potting industry and its impact on other native potting industries in South Africa were described. Of much interest were papers dealing with the history and distribution of the bow and arrow in South Africa, the name 'Hottentot' in the records of early travellers, and the drums of the Zulu. An extraordinary Nyasaland dance mask was described. Skeletal remains from a gold prospecting trench in the Matopos were, on the whole, considered to be of Bushman origin. The results of culture contacts on the Xosa and Pondo families were reviewed.

In Section F, economists discussed the relations of currency and capital, the economics of the hire-purchase system and the scope and method of business economics. Historical papers dealt with the influence of the tsetse fly on South African history, early South African rock inscriptions, early road administration in the Cape and mining in South Africa, and a defence of Sir Benjamin D'Urban was presented. Educationists discussed the present system of vocational training, an experimental scale for measuring the attitude of the white to the native, Freudian classification of the instincts and its application to some problems of civilisation. Basic English was recommended as a foundation for bilingualism. An interesting analysis of what becomes of boys after they have left school was given. A paper of outstanding social importance dealt with education and economic condition in relation to size of family, the results embodying analysis of such in connexion with nearly 50,000 families.

The next annual meeting of the Association will be held at Barberton, under the presidency of Dr. H. Spencer Jones, in July, 1933.

H. B. FANTHAM.

The 'Butterfly' Map Projection

IN NATURE of October 22 an account was given of the "'Butterfly' Map Projection" devised by Mr. B. J. S. Cahill, of Oakland, California. To save space and to use *one* instead of *three* world maps, Mr. Cahill combined his three variants in one drawing which he referred to as a *diagram*. We regret, however, that the writer of the article in NATURE misconceived the diagram, so that his comments upon it misrepresent the character and value of the projection. In justice to Mr. Cahill we print below a condensed statement sent by him referring to the completion of the theory, tabulated computations and diagrams of his decentralised octahedral system of projection begun thirty years ago.

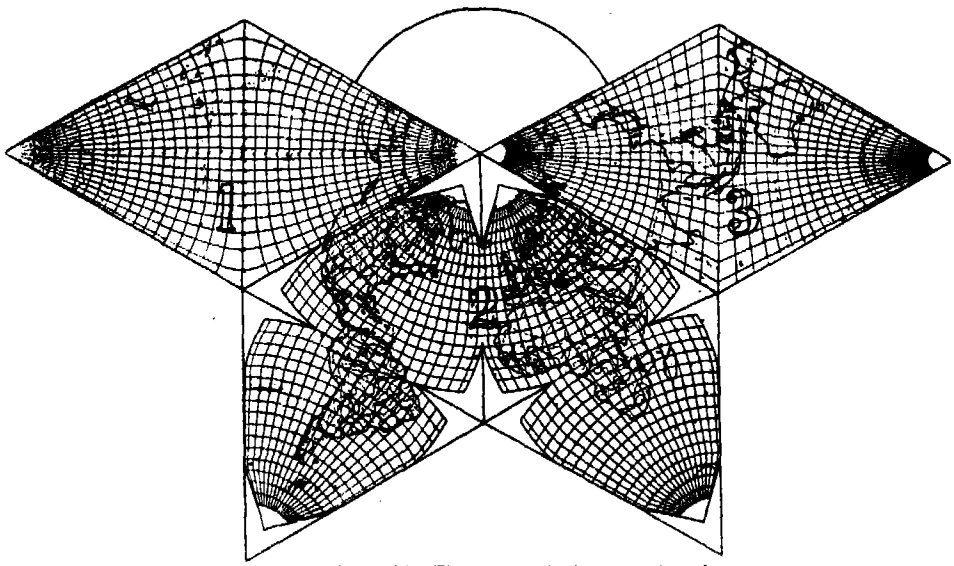


FIG. 1. Butterfly map of the world. The three variants are condensed to one diagram.

Earlier accounts published in Edinburgh 1909, Boston 1912, Gotha 1914, etc., describe a single 'maid-of-all-work' map now superseded by The Three Variants here condensed to one diagram (Fig. 1) and severally defined as to scientific quality and specific application as follows:

(1) The Orthogonal, Conformal or Orthomorphic Variant, a three-way continuum, rhombic type, for use mainly as an international meteorological base map from which local synoptic charts are cut, to be reassembled after isometrical data is added to form *daily single weather maps in the interest of* long range forecasting.

(2) The Authalic, Equivalent or Orthometric Variant, a land map for anthropogeographical, statistical, economic, educational and general geosophical purposes.

(3) The Gnomonic, Central or Orthodromic Variant, with double tetrahedral extensions, for geodesic, navigational and geophysical problems of sea, land, air or 'ether'. The practically undistorted eight charts of this variant are to have full topographical details. Alternate sets of four of these charts are also enlarged by encroaching on one-third of the adjacent ones to cover the facets of right and left enveloping tetrahedrons, thus yielding two sets of reciprocally overlapping expansions of

the original octants, since any octahedron can, by adding small tetrahedrons to alternate faces, be extended to positive and negative large tetrahedrons. By means of this fortunate geometrical fact the orthodromic service of this double set of tangent planes exceeds by far the service of any single plane possible.

Supplementing this variant are simple graphic diagrams for (*a*) continuing any line from chart to chart around the world, (*b*) joining any two points anywhere in one great circle, (*c*) measuring with precision all distances whether across any one, four or six charts, (*d*) converting all forward and retro-azimuths to true compass directions or vice versa to or from any point on the entire globe.

The 'Butterfly Map' is deliberately designed and mathematically detailed to meet the needs of ever growing world-wide problems and to help mankind above all things "to learn to think planetarily".

Atmospheric Tides

IN a paper entitled "Tides in the Atmosphere", in *Scientific Monthly* for August, J. Bartels gives a simple summary of our present knowledge concerning phenomena that would interest many people but for the intricate mathematics involved. He states that these tides have been studied lately by magneticians rather than by meteorologists because they assist the interpretation of terrestrial magnetic data. The main facts deserve, however, to be noted by meteorologists and others for whom this summary should, therefore, be of value.

It appears that our understanding of atmospheric tides still rests mainly on the resonance theory of Kelvin, developed later by Rayleigh and Margules. Analysis of long series of barograms has brought to light several small periodic variations of atmospheric pressure due to the tidal action, either thermal or gravitational, of the sun and the moon, and tidal theory is largely successful in accounting for them. The relative simplicity of atmospheric as opposed to oceanic tides, it may be noted, is due to the fact that the resonance properties of the atmosphere as a whole enhance the world-wide oscillations and repress local irregularities. Of the solar tides there are the travelling 12 hour wave with maxima at 10 a.m. and 10 p.m. local mean time, the 12 hour wave between polar and equatorial regions, with fixed nodes in about latitudes 35° N. and S., the 8 hour travelling wave, which shows a reversal of phase between summer and winter, and the 24 hour travelling wave. The two 12 hour waves and the 8 hour wave are appreciable mainly because the resonance factor for them is large. In the case of the 24 hour wave on the other hand, because of the very small resonance factor, the amplitude is very small in spite of the magnitude of the 24 hour temperature wave that causes it. The demonstration of the existence of the small lunar 12·4 hour and of the much smaller 24·8 hour wave is a recent success, Airy having failed to find even the 12·4 hour wave from an analysis of no fewer than 160,000 hourly observations at Greenwich. These lunar waves are simple gravitational waves owing little to resonance.

An interesting point is that the favourable resonance properties of the atmosphere for the 12 hour and 8 hour waves is apparently fortuitous. If the earth were to lose about thirty per cent of its atmosphere, none of the world-wide oscillations of pressure would be observed.

University and Educational Intelligence

BIRMINGHAM.—At a degree congregation held on December 16, the degree of D.Sc. was conferred on William Leach for numerous published papers on plant ecology and on plant physiology, especially on respiration.

Fourteen candidates also received the degree of Ph.D., namely: two each in physics, civil engineering, mining, metallurgy, and zoology, and one each in botany, chemistry, electrical engineering, and mechanical engineering.

CAMBRIDGE.—Dr. T. C. Phemister, of St. John's College, has been appointed University demonstrator in mineralogy and petrology in succession to Dr. A. G. Hutchinson, who has resigned.

Mr. C. F. A. Pantin, of Trinity College, has been nominated to use the University's table at the Zoological Station at Naples.

Dr. R. McG. Carslaw, of St. John's College, has been appointed advisory economist and head of the Farm Economics Branch.

It has been decided that in the regulations for the John Humphrey Plummer professor of inorganic chemistry, the word 'inorganic' should be replaced by 'theoretical'.

EDINBURGH.—The University Court has received with great regret intimation from Sir Edward Sharpey Schafer of his intention to retire from the chair of physiology at the end of the current academical year. He was appointed to the chair in 1899.

On the recommendation of the Senatus, Dr. J. B. Todd, lecturer in engineering, has been appointed a reader.

LONDON.—Major-General Sir Frederick Maurice, professor of military studies and member of the senate of the University of London, has been appointed principal of East London College as from the commencement of next session in succession to Mr. J. L. S. Hatton.

PROF. H. B. FANTHAM, professor of zoology in the University of the Witwatersrand, has been appointed Strathcona professor of zoology in McGill University, Montreal, in succession to Prof. A. Willey, and is taking up his new appointment immediately.

THE Cecil Peace Prize for 1932 has been awarded to Mr. A. J. Mackenzie, of the University of Edinburgh, for an essay on "The Danger from the Air. Discuss Possible Methods, by International Convention or otherwise, of dealing with it". This prize of £100 is offered yearly for an essay on a subject bearing on the principles or work of the League of Nations and is open to students less than twenty-five years of age of any university or university college in Great Britain or Northern Ireland.

THE annual meeting of the Mathematical Association will be held at the Institute of Education, Southampton Row, London, W.C.1, on January 5–6, under the presidency of Prof. G. N. Watson. Several papers will be read and a discussion on "The Study of Statistics in a School Course" will be opened by Mr. F. Sandon. The presidential address, to be delivered on January 5 at 3.45, will be entitled "The Marquis and the Land Agent: a Tale of the Eighteenth Century". Further particulars can be obtained from the Hon. Secretary, Mr. C. Pendlebury, 39 Burlington Road, Chiswick, W.4.

Calendar of Geographical Exploration

Dec. 25, 1539.—Discovery of the Amazon

Gonzalo Pizarro, brother of the conqueror of Peru, set out from Quito to find if there was truth in the rumour that beyond Quito was a land where cinnamon grew. His party crossed the snowy Cordilleras and in the valley of the Napo experienced two months of steady rain. Forest impeded their progress, so Pizarro built a ship in which Orellana was sent ahead to find food to bring back to the starving party. Orellana found none and instead of returning sailed down the Amazon to the sea. Pizarro, with the remnant of his party, returned to Quito in June, 1542. The discovery of the Amazon was dearly bought, for of Pizarro's party, 4000 Indians and 210 Spaniards perished.

Dec. 27, 1831.—Voyage of the *Beagle*

H.M.S. *Beagle* sailed from Devonport under Capt. FitzRoy to carry out surveys in South America and some islands of the Pacific and also to make chronometrical observations. The voyage became memorable because Charles Darwin was invited to accompany the expedition, which lasted nearly five years. He afterwards published his famous journal, and undoubtedly much of his subsequent work was inspired by this journey and especially by what he saw in the Galapagos Islands. (See NATURE, 128, 1065, Dec. 26, 1931.) The *Beagle* supplemented the surveys begun by King and FitzRoy in 1826–30 on the coasts between the Plate River and Chiloé; it completed the coast survey as far as Guayaquil. The Santa Cruz River was followed inland for about 250 miles to within sight of the Andes. In addition, FitzRoy visited the Paumotu Archipelago, the Society Islands, New Zealand, Australia and the Keeling Islands, in the course of his circumnavigation of the globe.

Societies and Academies

LONDON

Society of Public Analysts, Dec. 7.—J. Cecil Maby: Further notes on the identification of woods and charcoals. The characteristic structures of the charcoals of hazel, horsechestnut, hawthorn and apple were described and the difference between the 'sycomore' wood of the ancient Egyptians and English sycamore was demonstrated.—Winifred E. Smith and Edith K. Waller: The characteristics of millet oil. Whole millet seed yielded 3·9–4·7 per cent of a semi-drying oil consisting mainly of glycerides of linolic and oleic acids, and having a high acid value. It contained nearly 5 per cent of unsaponifiable matter, from which was separated a crystalline compound, melting at 285° C. and having an elementary composition differing from the 'panicol' described in 1888 by Kassner.—H. N. Griffiths, T. P. Hilditch and J. Rae: The stability of vitamin A in cod liver oil emulsions. The vitamin A potency of cod liver oil emulsions as measured by the antimony trichloride test and spectrographic examination, showed no appreciable decrease (as compared with the original oil) for at least four months. At six months there was evidence of some change, but chiefly in the original oil. If kept in well-stoppered amber glass bottles in the dark, cod liver oil emulsions could probably be kept without appreciable alteration for seven or eight months. Development of acidity in emulsified oils is attributed to the presence in minute quantity of a lipoclastic anærobic organism.—E. Lester Smith: The validity of the Lovibond tintometer method in the assay of vitamin A. A suitable technique for making accurate measurements of the blue coloration in the antimony trichloride test by means of the Lovibond tintometer was described; the results thus obtained agree closely with the vitamin A potency of an oil, as measured by the spectrographic method.—A. I. Bacharach, E. Lester Smith and S. G. Stevenson: Some physical and chemical properties of ergosterol and calciferol. An outline was given of the probable constitution of ergosterol and its derivative calciferol, and the melting points, optical rotation and other physical and chemical properties of the two compounds were tabulated.

EDINBURGH

Royal Society, Dec. 5.—A. G. Hutchison: The metamorphism of the Deeside Limestone, Aberdeenshire. This limestone, which Prof. Read has correlated with the Loch Tay limestone of the Central Highland Dalradian succession, is in the sillimanite grade of regional metamorphism. The occurrence of plagioclase felspars more basic than oligoclase distinguishes it from the Loch Tay diopside limestones of the almandine zone. Contact metamorphism by newer granites produces hornfelses referable to Goldschmidt's classes 7–10, and unstable types. Subsequent pneumatolytic and hydrothermal action accounts for pegmatites and limestone with scapolite, prehnite, zeolites, etc. The order of formation of minerals in the hydrothermal phase with falling temperature is grossular (doubly-refracting), zoisite-epidote, albite, prehnite, analcite, thomsonite and apophyllite. Successive alterations of the interbedded greenstone series are also considered.—Mary G. Calder: Notes on the Kidston collection of fossil plant slides, (1.) The anatomy of the axis of *Lepidodendron Brownii* Unger sp., with special reference to the relationship between this stem and *Lepidostrobus Brownii* Unger sp. A previous description by Prof. Chodat in 1911, having been made from a single transverse section, does not mention certain important features of the pith, xylem, phloem, outer cortex and leaf-traces. The comparison with *Lepidostrobus Brownii* has been revised and more fully discussed, particularly with reference to the cone pedicels, not known to Prof. Chodat, which were described by Zeiller in 1911. Prof. Chodat's identification of the stem as the vegetative axis which bore the cones known as *Lepidostrobus Brownii* receives further confirmation.—W. J. Hamilton: Restoration and regeneration of the epithelium and endometrium of the uterus of *Cavia* after parturition in non-pregnant animals. This process has not hitherto been described in detail in the guinea pig. After parturition the uterus is completely lined by columnar epithelium except where the placental pedicle was attached. This site becomes a cleft filled with organised blood-clot over which new epithelium grows. The old epithelium is shed from the rest of the uterus and new epithelium formed from gland mouths, consisting first of flattened cells which become cuboidal and ultimately columnar. Below the union of the uterine horns restoration is by the superficial endometrial mesodermic cells becoming epithelial. *Pari passu* the endometrium is restored from a fibrous to a cellular structure.—H. Briggs and R. P. Sinha: Expansion and contraction of coal caused respectively by the sorption and discharge of gas. Small but definite linear expansions in eight varieties of coal, in consequence of their

contact with methane or carbon dioxide under pressure, were measured by the authors and shown graphically. Pressures ranged from zero to 300 lb. per sq. in. The coal specimens were prepared in prisms about 75 mm. long, and the specimens included two of anthracite, two of durain, three of clarain (mixed durain and vitrain) and one of impure cannel. The physical reaction in most cases took a long time to reach completion; though small, it is definite and apparently reversible. The effect of adsorbed moisture was briefly discussed. The corresponding changes due to dry coal adsorbing moisture had yet to be investigated.—W. O. Kermack, W. H. McCrea, and E. T. Whittaker: On properties of null geodesics, and their application to the theory of radiation. The conception of a transport vector along a null geodesic is employed first to derive a new general definition of spatial distance, and secondly to derive a new invariant depending on two neighbouring null geodesics. The latter is used to obtain a general formula for the Doppler effect in general relativity. The same result holds for propagation by waves and by light quanta. The Doppler effect vanishes for two systems at relative rest, with a very general definition of relative rest. Some special cases are worked out in detail.—L. T. Hogben: A matrix notation for Mendelian populations. By the use of a matrix notation the unwieldiness of expressions encountered in the theory of consanguineous unions, systems of inbreeding and correlation of relatives when transmission is sex-linked can be avoided. The appropriate operations are defined and illustrated by application to known theorems of inbreeding and a series of new theorems concerning consanguineous matings are given.—A. C. Aitken: Graduation of data by the orthogonal polynomials of least squares. In the fitting of polynomial curves to equidistant data the use of the orthogonal polynomials of Tchebychef is known to possess great advantages. The author develops the properties of these polynomials, gives new forms for them, and introduces new arithmetical methods depending on repeated central summation.

CRACOW

Polish Academy of Science and Letters, Oct. 10.—**W. Swietoslawski**: A universal boiling point apparatus and its application. By means of this apparatus the following three temperatures may be determined: the boiling point of the liquid (solution), the condensation temperature of the first bulb of the fractionating column, and that of the condensation after the vapours have been fractionated.—**W. Swietoslawski, Mlles. A. Dorabialska and E. Turska**: The spontaneous emission of neutrons by certain non-radioactive elements. The analysis of the table of the known elements shews that the α-, β- and H-transformations cannot explain the production of the existing isotopes, without admitting the possibility of the emission of neutrons. Attempts at proving the decomposition of elements with production of neutrons have resulted in the proof of neutron emission in the cases of sodium fluoride and metallic arsenic.—**J. Biborski**: The histological structure of the veins of the frog, *Rana esculenta*.—**S. Sekutowicz**: Studies on the development and the biology of *Caryophyllaeus laticeps*.—**Z. Raabe**: Researches on certain species of the genus *Conchophthirus* Stein.—**J. Jakobiec and T. Marchlewski**: The influence of repeated connexion between closely related animals on the biological characters and the commercial value of the domestic pig.

SYDNEY

Linnean Society of New South Wales, Sept. 28.—**J. McLuckie and A. Burgess**: Mycotrophism in the Rutaceae. (1) The mycorrhiza of *Eriostemon Crowei* F.v.M. Two fungi are recorded as occurring in the young roots. One is a phycomycetous form giving rise to arbuscules and vesicles, the other, a moniloid type resembling *Rhizoctonia*. This affords confirmation of Peyronel's double infection theory. From a physiological point of view the former is more important. Large quantities of fatty substances accumulate in its hyphae and are afterwards transferred to the host, thus augmenting its carbonaceous supplies. In addition 'vesicles' are formed. These contain numerous nuclei and are packed with fat. Later the contents are withdrawn and the structures collapse. It is suggested that these are reproductive bodies the functions of which have been interrupted.—**G. H. Hardy**: Two new Australian species of *Pollenia*. One Victorian and one Queensland species of the genus are described and their genitalia figured.—**G. H. Cunningham**: The Gasteromycetes of Australasia. (15) The genera *Mesophellia* and *Castoreum*. Both genera are members of the Lycoperdaceae, though differing sufficiently from other genera placed therein to warrant the erection of a third tribe to contain them. *Mesophellia* contains two or possibly three species, namely *M. arenaria*, *M. pachythrix* and *M. castanea*, which are confined to Australia and Tasmania. *Castoreum* likewise contains three species, *C. radicatum*, *C. avellaneum* and *C. cretaceum*, also endemic to Australia and Tasmania.

Royal Society of New South Wales, Oct. 5.—**F. W. Booker**: Note on the internal structure of *Barrandella* and *Sieberella*. The descriptions of *Barrandella linguifer*, Sowerby, and *Sieberella galeata*, Dalman are amended and a comparison with *Barrandina Wilkinson* and *B. minor*, is made.

Forthcoming Events

TUESDAY, DEC. 27

ROYAL INSTITUTION, at 3.—(Christmas Lectures). Prof. A. O. Rankine: "The Round of the Waters" (succeeding lectures on Dec. 29, 31 and Jan. 3, 5 and 7).

Official Publications Received

GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research. Report of the Radio Research Board for the Year 1931. Pp. iv+123. (London: H. M. Stationery Office.) 2*s*. net.

The Quarterly Journal of the Geological Society of London. No. 352, Vol. 88, Part 4. Pp. 515–711+plates 31–46. (London: Longmans, Green and Co., Ltd.) 7*s*. 6*d*.

List of Geological Literature added to the Geological Society's Library during the Year ended December 31st, 1931. Pp. iv+303. (London: Geological Society.) 10*s*.

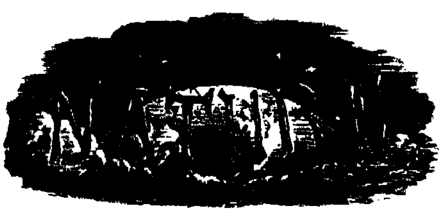
The Journal of the Board of Greenkeeping Research. Vol. 2, No. 7, Autumn 1932. Pp. 223–302+viii+4 plates. (Bingley: St. Ives Research Station.) 2*s*. 6*d*.

OTHER COUNTRIES

Field Museum of Natural History. Geology Leaflet 13: The Geological History and Evolution of the Horse. By Elmer S. Riggs. Pp. 54+19 plates. (Chicago.) 40 cents.

U.S. Department of Commerce: Bureau of Standards. Miscellaneous Publication No. 138: Annual Report of the Director of the Bureau of Standards to the Secretary of Commerce for the Fiscal Year ended June 30, 1932. Pp. ii+40. 10 cents. Bureau of Standards Journal of Research, Vol. 9, No. 5, November, Research Papers Nos. 493–500. Pp. 583–709. 25 cents. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Bulletin 158: The Copepods of the Woods Hole Region, Massachusetts. By Charles Branch Wilson. Pp. xix+635+41 plates. (Washington D.C.: Government Printing Office.) 75 cents.



SATURDAY, DECEMBER 31, 1932

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Science and Empire Building

IT is distinctly unusual for the Governor-General of a great Dominion to deliver an important scientific address; yet that is what recently happened in New Zealand when Lord Bledisloe gave the Cawthron lecture, which is there regarded as the annual pronouncement *par excellence* on modern movements in science and their relation to the life of the community. Lord Bledisloe chose as his title "A Conspectus of Recent Agricultural Research" and the choice was doubly happy in that the subject is of profound importance to the people of New Zealand and that he himself is so well qualified to deal with it. Nowhere in the world is scientific agriculture more highly developed and nowhere can one gather a more discriminating and better informed audience to listen to an agricultural lecture than at the Cawthron Institute on the occasion of this annual function.

The cordial welcome given to the discourse by the New Zealand Press was much more than a compliment to the popularity of the Governor General. The address is admirable both in range of subject matter and in presentation.* Lord Bledisloe begins appropriately with an account of the work on soils and plant growth, this being fundamental to all agricultural systems. The account of the Rothamsted experiments on cultivation and fertilisation of crops and on the making of new pastures is followed by a description of the Jealotts Hill investigations on the intensive manuring of pastures, and of the Aberystwyth work on the improvement of hill grazing. This naturally leads to a survey of the effects of mineral deficiencies on the composition of the herbage and on the health of the animals grazing thereon. Fundamental studies on this subject are made at the Rowett Research Institute at Aberdeen, but New Zealand has contributed in no small measure to the advances made in recent years.

Stress is rightly laid on the need for an adequate soil survey of the country. Much is already being done in New Zealand and appropriate methods are being worked out: meanwhile the underlying principles are being studied at Rothamsted, Bangor, Aberdeen and elsewhere.

Dairy research comes in for a great deal of attention because, as Lord Bledisloe rightly points out, uniformity in the butter and the cheese exported to Great Britain is an essential condition of their saleability and stable reputation in British

* Copies of the lecture can be obtained from Messrs. Whitcombe and Tombs, Ltd., 3 Addle Hill, London, E.C.4, price 1s.

markets. Nothing has contributed more to the attainment of this desirable characteristic than the production of commercial 'starters' commenced in Denmark some forty years ago and now widely used wherever dairying has become a science. So much research has been done on the feeding of animals and so advanced is the good farmer's knowledge of this subject that, in Lord Bledisloe's view, "if the average human being knew as much about the feeding of himself and his children as the average farmer knows about that of his stock, the average standard of human health and physical energy would be at least 33 per cent higher than it is. Probably as much as 50 per cent of the therapeutic activities of physicians, druggists and clinics is referable, directly or indirectly, to avoidable dietetic indiscretions based on ignorance of the fundamental principles of animal nutrition".

This statement is supported by some remarkable evidence. It is stated, for example, that the Plunket or Truby King system of feeding infant children has reduced the New Zealand rate of infant mortality under twelve months from 80 per 1,000 in 1889 to 32 per 1,000 in 1932, a figure which gives New Zealand the best record in the world and compares with 71 per 1,000 in England and Wales, 109 in Germany and 124 in Italy.

The chief export from New Zealand is wool, and no small part of the present depression in New Zealand is due to the low prices now obtained owing to the quantity of this commodity on the market; every penny per pound of wool sold represents £1 million in the national revenue. Naturally New Zealand is deeply interested in the research work on wool now going on in Great Britain: the search at Leeds for definite standards of grading which would enable the manufacturer to tell the farmer exactly what types of wool he wants; the studies at Edinburgh of the inheritance of the more important characteristics of the wool; and the Rowett Institute investigations on the relation between the composition of food and the yield of wool.

Next in importance to wool, and probably of more significance for the future of the country, come the dairy and meat industries, both of which ultimately depend for success on low temperature transport. Great Britain will probably always be New Zealand's best customer and the journey will always have to be across the equator; however much it may be shortened, there will always be the need for low temperature transport and storage. Research on this subject is now being taken up seriously and scientifically at Cambridge and elsewhere, and further developments may be expected in the near future. It is very gratifying to observe how much of the work that made so strong an appeal to Lord Bledisloe's highly skilled audience had been done in the agricultural research institutes of Great Britain.

The address is important not simply because of its subject matter, but much more because of its significance. The British Empire was founded by adventurous soldiers and sailors; it was developed by courageous farmers and settlers who, often struggling against fearful odds, brought the land into cultivation, built roads, railways and cities, and laid out the countryside as a vast agricultural estate. It has been knit together by bonds of sentiment steadily growing among the people and fostered by wise statesmen, writers and teachers. But the lands of the Empire have nowhere reached the limits of their development. The first feeling of an agricultural expert in visiting any of the great dominions is one of wonder at the vast natural resources still awaiting development.

Courage and hard work have played and must continue to play their part; science has now come in, vivifying with magic touch many an enterprise that seemed beyond hope, and achieving tasks which but a short time ago would have been deemed impossible. No one can tell where the applications of science will stop; for the present, the one thing certain is that they will go on at an increasing pace, playing an ever-growing part in the lives of all who are so directly dependent on natural forces as are the agricultural communities of the dominions. The Empire builders of to-day are the men and women who in Great Britain and overseas are quietly studying the scientific problems that so deeply concern the comfort and well-being of those living in the distant lands.

The change has far-reaching consequences. More and more it is becoming essential that the administrator should have a full appreciation of the part that science should play in the life of the community. Lord Bledisloe's undoubted success in New Zealand is due in no small measure to the fact that he recognises the value of science and so is able to enter more sympathetically into the life and problems of the Dominion than would otherwise be possible. The Cawthron address of this year may well be a significant portent.

The Science of Society

Societal Evolution: a Study of the Evolutionary Basis of the Science of Society. By Prof. Albert Galloway Keller. Revised edition. Pp. ix+419. (New York: The Macmillan Co., 1931.) 12*s.* 6*d.* net.

ONE of the most vital and important contributions that science can make to modern thought must surely be in the realm of social science, of sociology, or the science of society—to use the older term now adopted by Yale University. The question of its exact definition and scope, or of its relations with other kindred sciences, such as economics, history, anthropology, politics, psychology, ethics, is of small moment compared with that of making a really worth while contribution to the solution of at least some of the problems of modern civilisation.

The most hopeful line of approach hitherto has been along the lines of evolution as applied to human society. This, however, has been found to be a much more difficult and complicated matter than, in the first flush of Spencerian enthusiasm, was anticipated; and even with the powerful aid of Benjamin Kidd all difficulties were by no means cleared away. The complexity of the subject is strongly emphasised in the remarkably able book by Prof. A. G. Keller under notice, in which the attempt is made to give sociological study a fructifying definite orientation, similar to that given by Darwin in biology. The author insists that the "reasoning by analogy" of previous writers on social evolution has been vague and largely futile. There is, in human society, something more than mere analogy to organic evolution: there is real and specific variation, selection, counter-selection, transmission (in place of heredity) and adaptation.

Keller soon makes it quite clear that he does not identify evolution necessarily with progress. He find it next to impossible to define progress. At best we can only have adjustment. Man remains, physically, "unchanged in a changing environment" because he uses his brain and social organisation to make the necessary adjustments for tolerable existence. Such adjustments, often beginning with individual acts to meet special needs, confirmed by trial and error, and finally adopted by the social group, ultimately reach the status of convention, public opinion, mores, laws, and religious sanctions.

One of the first great principles of social science here emerges. All social action is controlled by convention. Yet, says Keller, this convention or custom is of such labyrinthine complexity and general pervasiveness that it is a difficult conception to handle, and its reduction to a more manageable shape by Sumner in his "Folkways" was a real *tour de force*. One can readily echo this high praise of Sumner's work even from the brief synopsis here given. The folkways of primitive society are likened to the cells of organic life. The mores are an advanced stage of folkways and include a judgment that they are conducive to societal welfare. Their origin, the rise of institutions, morals, law, and religion are described, and at the same time the scientific student is warned against

> "The philosophers, a term which must be understood to mean medicine men, prophets, law-givers, sages, theologians, and poets, who try to think out into general propositions of world philosophy, or of rights and duties in ethics, those views of welfare which the mores suggest. They want to bring the experience and theory of the mores into relation with the sweeping horizon of ghost-fear or mythology, or with general conceptions of the 'good', such as the advantages of courage, truthfulness, hospitality, and fidelity to the spoken word. This is what has been called 'thobbery', that is, thinking (wishfully) without interest in actual verification" (from an unpublished fragment by W. G. Sumner).

This is not too clear; but it is characteristic both of Sumner and Keller that they have no undue respect for 'great men' either in the classes noted above under the term 'philosopher' or any other class.

The agent of variation, which is constantly going on or being attempted, is the individual, often a 'great man' or several of these acting independently under a common stress or need. At any stage there are plenty of budding variations in the mores to select from. Ideas tumble over each other in the face of the need which evokes them. In any great crisis, even though world-wide as at present, there is no lack of ideas. The difficulty is to test, judge, select, apply. Experiments must be made. There is, however, says Keller, a kind of automatic regulation of this matter which resides in the process of societal selection.

The intricate processes and methods of selection, irrational and rational, and of counter-selection, the product of humanitarianism, are dealt with at considerable length. Selection is mainly effected

by the masses—the great bulk of the people with the supermen lopped off at the top and the defectives lopped off at the bottom of Sumner's turnip diagram. The Sumner-Keller view is that the masses are conservative, living on tradition and habit, the result of inertia. The folkways are their ways. They accept influence or leadership or new teaching, but not always in the form in which it is offered to them. They assimilate it slowly and with frequent modification. It is wrong to think they have any occult wisdom or inspiration by virtue of which they select what is wise, right, good. The 'great man theory', as expounded, for example, by Carlyle in his "Hero-Worship", is fundamentally different from, indeed it is the complete antithesis of, the views here expressed. Keller says the great man is merely the product of his time and its needs: he is only incidental. The results attributed almost solely to him would have come to pass in any case. He has had the luck, together with some natural endowment, to see and to some extent anticipate the impending changes. Another great principle here then emerges: the determining social cause of change is something very different from the human agency. "The latter is always secondary and relatively incidental and wholly ineffective by itself. To confuse the two is to miss essential truth. *The effective cause lies in the unpremeditated movement of the masses of men.*"

The difficulties are real enough and loom up mountainously, especially in connexion with those irresistible impersonal forces which Keller so often mentions and which, in his view, are the final arbiters of human destiny, though they originally seem to spring from the mores and are thus of human origin. Are they then so completely uncontrollable, irresistible, and impersonal?

Sumner says that the sound student of sociology can hold out to mankind as individuals or as a race only one hope of better and happier living. That hope lies in an *enhancement of the industrial virtues and of the moral forces which thence arise.* Industry, self-denial, and temperance are the laws of prosperity for men and States; without them, advance in the arts and in wealth means only corruption and decay through luxury and vice. The power of the human race to-day over the conditions of prosperous and happy living is sufficient to banish poverty and misery if it were not for folly and vice. This is splendid and should inspire a comprehensive plan of action for the present age. But have we in all this those arbiters of human destiny, those irresistible impersonal forces on our side? It would seem so; for Keller says that they invariably act in the direction of making the right adjustment, the one that is expedient for any particular time and environment. The old questions again arise: To what extent can man control his destiny, and how far can science alone go?

'The power of the human race' is a fine phrase. That power is undoubtedly greater than is often imagined. With this tremendous latent power awakened under the right stimulus, the urgent need, the national crisis, the faithful lion-hearted leadership, and with all the forces of the modern State, scientific, industrial and the rest, what could not a great nation accomplish, if, to all this, we add intelligent world co-operation? We find it a little difficult to reconcile these possibilities with those mysterious irresistible impersonal forces —resident in the masses—which yet work to human ends to the extent at least of making expedient adjustments. Nor do we think Keller quite appreciates the part played by the great man in history. There is doubtless much in what he says, but his examples here are not too happily chosen, and we still incline to the Carlylean view. Then again, as to progress, quite possibly from a strictly evolutionary point of view, we cannot necessarily expect progress. But yet, even at the risk of being guilty of 'thobbery', we must have some ideal at which we can aim, some sense of progress, or possibility thereof, for without this a science of society is going to be insipid. Perhaps the evolutionary point of view is inadequate. We think, further, that the author has underrated the potential hopes which reside in social experiment, in definitely planned policies of reconstruction and betterment. He says (page 205):

"This kind of thing (experiment and verification) may not be done in the domain of the social sciences, for the mores forbid man to experiment upon man. What goes by the name of social experimentation lacks rigor in its processes and emerges with vague and inconclusive results. The best the social scientist can do is about equal to the worst the natural scientist has to put up with: to wait on nature to perform quasi-experiments for him and to search history for those she may have performed."

The difficulties of social experiment are undoubtedly great, but does the above quotation adequately portray all that lies in this direction? It seems that it is precisely here that the greatest and highest hopes of social science must reside;

just here that it may hope to find means to rise to the rank of a true science based largely on experiment. The present writer has often reflected on the fair and stately prospects of an experimental sociology. In NATURE of Sept. 10, pp. 392–3, commenting on the excellent articles by Dr. Jacks and Prof. Miles Walker, it is stated that the time is opportune for courageous and adventurous experiment, and this is only too true.

The prospects of successful experimental methods are closely bound up with environment and the extent to which it can be controlled; but here Keller is comparatively silent. He says little about environment, though it is the supreme and all-important factor in evolution, especially in 'societal' evolution. In this latter it must differ in many fundamental ways from organic or natural environment. Among other things it should be more amenable to control, for example, slum-clearing. Many of the parts or items in environment are themselves subject to evolutionary processes. Keller observes, for example, that religion is a life condition of the first magnitude, yet he considers that, too, is subject to evolution. All this and much other vitally important and interesting matter could be discussed under the heading of environment. It is indeed as much deserving of a chapter to itself as variation or selection.

W. G. L. C.

Land and Fresh-Water Molluscs

Fédération française des Sociétés de Sciences naturelles : Office central de Faunistique. *Faune de France*. 21 : *Mollusques terrestres et fluviatiles* (première partie). Pp. 477 + viii + 13 plates. 22 : (deuxième partie). Pp. 479–897 + ix–xiv + plates 14–26. By Louis Germain. (Paris : Paul Lechevalier, 1930–31.) 150 francs each.

THE preparation of this work has involved a critical revision of the land and fresh-water molluscs of France, during which the author has made full use of the rich material at his disposal in the Museum d'Histoire Naturelle in Paris. One of the results of the revision is that a large number of species have been reduced to synonyms.

A short account of the anatomy of the gastropods and the lamellibranchs precedes a consideration of the characters of the shells and their anomalies and abnormalities. Passing to the faunistic section, the author distinguishes three principal associations of land molluscs—the hygrophilous, the xerophilous and the forest groups. The aquatic molluscs also fall into three series according as they live in running water, in quiet or stagnant water, or in large lakes. The most characteristic members of each of the six groups are named. In a short note on the molluscan fauna of the mountains the author states that the maximum altitude at which a large number of species live is known with considerable precision for the alpine region but less fully for the Pyrenees. Only a few terrestrial species, for example *Vitrina nivalis*, can exist under the severe conditions found at a height of about 3000 metres. This species disappears below about 2300 metres. Of the lamellibranchs, *Pisidium casertanum* is found in lakes at an altitude of about 2200 metres in the Pyrenees and up to 2500 metres in the Alps. For most of the species the author states the maximum height at which they have been found.

The molluscan population of France, which includes representatives of the majority of the European genera, falls into three groups—the southern, which is essentially Mediterranean in origin, the Atlantic or Lusitanian, and the northern, though these have not entirely preserved their individuality as migrations have taken place; for example, some of the Mediterranean species have migrated northwards even to the shore of the Channel. Lists of the characteristic species of the three groups are given. Useful observations on polymorphism precede the dichotomous keys to the 41 families of gastropods and the three families of lamellibranchs, to the genera and to the species which comprise the terrestrial and fluviatile molluscs of France.

Carefully devised dichotomous keys form a special feature of the "Faune de France" series and the present author has devoted much care to their preparation in this work. The characters of each genus and species are concisely but adequately described and notes are added under each species on the habitat, biology and distribution. The illustrations consist of twenty-six good collotype plates reproducing photographs of the shells of large or moderate size, and 860 text-figures of the small shells, considerably magnified, of characteristic details of shells and of the reproductive organs of the genera and subgenera of the gastropods. A bibliographical list (pp. 46) and a full systematic index are added. This work is commendable for its careful attention to the biology as well as to the systematics of the terrestrial and fluviatile molluscs.

Electrochemistry

Handbuch der Experimentalphysik. Herausgegeben von W. Wien und F. Harms. Unter Mitarbeit von H. Lenz. Band 12: *Elektrochemie.* Herausgegeben von K. Fajans. Teil 1: *Leitfähigkeit und Überführungszahlen in flüssigen und festen Elektrolyten.* Von Prof. Dr. L. Ebert und Prof. Dr. C. Tubandt. Pp. xvi + 496. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932.) 45 gold marks.

THE last decade witnessed a violent revolution in our fundamental conceptions of the electrochemistry of solutions, in the course of which the classical theory of Arrhenius, postulating incomplete ionisation of strong electrolytes and constant ionic mobilities, was dethroned in favour of the Debye-Hückel theory, postulating complete ionisation with ionic mobility a function of concentration. In a sense, this revolution is still incomplete, since several important points in the Debye-Hückel theory are not yet satisfactorily developed and the original ideas of Arrhenius must still be called into service in connexion with weak and transition electrolytes, but remarkable changes have been effected in a domain where conditions were long regarded as settled and, after a great deal of natural hesitation in certain quarters, practically all the experts in the field have now reconciled themselves to the new regime.

The work under review offers a comprehensive account, both practical and theoretical, of the present state of affairs with regard to electrical conductivity and transport numbers in liquid and solid electrolytes, leaving electromotive force and polarisation for a second 'half-volume'. It is true that many portions of the field here covered have already been more or less satisfactorily treated in smaller separate monographs, but the difficulty of correlating these with one another has considerably diminished their usefulness, and awkward gaps in their alignment frequently rendered the original literature the only safe guide for the inquiring investigator.

The greater part of the book, naturally, is occupied with a discussion of the conductivity of liquid electrolytes. Methods of measurement, with all the modern refinements thereto, are described in detail, and the interpretation of the experimental results is systematically and simply presented. This section, together with the succeeding chapters on transport numbers in liquid electrolytes, is the work of Prof. L. Ebert of Würzburg. The concluding portion, which deals with conductivity and transport numbers in solid electrolytes, has been written by Prof. C. Tubandt of Halle, and is largely a description of his own important contributions to these very difficult topics.

It is interesting to note that the scope of the volume throughout is international rather than national, the contributions of British and American research workers being very generously acknowledged. Altogether, the volume is one which can be commended without hesitation to electrochemists of all ages and all stages.

JAMES KENDALL.

Blackwater Fever

Researches on Blackwater Fever in Southern Rhodesia. By Dr. G. R. Ross. (No. 6 of the Memoir Series of the London School of Hygiene and Tropical Medicine.) Pp. vi + 262. (London: London School of Hygiene and Tropical Medicine, 1932.) Paper, 8*s.*; cloth, 10*s.* 6*d.*

THIS report is the result of the work done by the author during his tenure of the Rhodesian research fellowship from April 1925 until April 1929. It is divided into three parts, the first of which is concerned with the epidemiology of the disease.

In a chapter describing the distribution of blackwater fever among the population of Southern Rhodesia, there is an interesting table which records the number of cases of the disease admitted to hospital and the number of fatal cases during each of the years 1914–28. The total cases numbered 679 and the deaths 152, giving a fatality rate of 22·2 per cent. It is significant that whilst the fatality rate varied considerably in different years, it showed no general tendency to decrease during the 15 years under consideration; in the four years, 1914–17, it was 24·2 per cent and in the last four years of the period, 1925–28, it was 27·9 per cent. These figures, which are by no means unique, might with great advantage be borne in mind by those who, being more highly endowed with optimism than with critical judgment, see fit to make extravagant claims for the success of particular lines of treatment based upon the observation of half a dozen cases or even, alas, of only one or two.

Part 2 is concerned with the changes in the blood and urine occurring in the disease. The author has rightly assessed the importance of

examination of these fluids in any investigation designed with the object of elucidating some of the many mysteries of blackwater fever. Much valuable information has been collected, but it is unfortunate that Dr. Ross was unable to make any quantitative estimations on the degree of hæmoglobinæmia during the passage of blackwater. The matter is of such importance for an understanding of the mechanism of the disease, and so many diverse statements, based frequently on careless and inadequate observations, appear in the literature of the subject, that new, and carefully made, quantitative estimations of the hæmoglobinæmia in blackwater fever are greatly to be desired.

On the all-important subject of the mechanism of suppression of urine in blackwater fever, the author writes as follows:

"One is thus forced to conclude that suppression cannot be entirely explained by the assumption that it depends principally upon the sodium chloride content and the acidity of the urine. If the phenomenon is to be explained by purely physicochemical reasons, the part played by other electrolytes present in the urine would seem to be equally important to that played by sodium chloride. It seems preferable to adopt the view of *Yorke and Nauss* (1911) that precipitation depends upon the degree of concentration of the urine and is facilitated by any factor which interferes with the secretion of water by the malphigian body. This may result from damage as a result of the excretion of the foreign protein hæmoglobin, from lowering of the blood-pressure, or for more obscure reasons."

In Part 3, which consists of clinical observations and of remarks on prophylaxis and treatment, the author discusses in some detail the question of the alkaline treatment of the disease. He writes that this method of treatment has received such extensive publicity that there is some danger of its being regarded as a panacea. Whilst he agrees with Baker and Dodds that in *in vitro* experiments precipitation of hæmoglobin takes place according to the conditions they describe, Dr. Ross considers that the time necessary for precipitation to occur makes it difficult to imagine such changes taking place during the passage of urine down the renal tubule. He favours the older view of Yorke and Nauss (1911), as stated above, that precipitation depends upon the concentration of the urine and is facilitated by any factor interfering with the secretion of water by the malphigian body. He is thus not inclined to favour the alkaline treatment more than any form of treatment which has copious diuresis as its object.

Dr. Ross is to be congratulated on an excellent piece of work, for not only has he made many valuable observations himself, but also he has collected together from an enormous and scattered literature the relevant observations of other workers; and he has brought the whole mass together into a single volume of moderate size wherein it is possible to discover the present position of knowledge on any of the many problems which this mystifying disease presents.

Short Reviews

Natural Varnish Resins. By T. Hedley Barry. Pp. xii + 294. (London: Ernest Benn, Ltd., 1932.) 42*s.* net.

ALTHOUGH we hear much of synthetic resins nowadays, the natural resins lose none of their importance in the industrial arts, and it is useful to have a comprehensive work on the subject by an author of such repute in the varnish industry. To some extent it is a development of a previous book, covering also the synthetic resins, by Barry, Morrell and Drummond, and the experience then gained has been used in bringing the present work thoroughly up to date. It is divided into two parts, the first, covering some forty pages, dealing with such general questions as the physical properties, solubility, constituents and chemical examination of resins. In the second part the individual resins are described at length.

Copious references are given to the original papers. The book is illustrated with maps and a considerable number of photographs. It is well produced, but the high price will tend to restrict its sale to industrial laboratories.

The salient facts as regards any particular resin relate to its origin and collection in different parts of the world, its analysis, and its chemical composition. The chemist has still a lot to do in elucidating the composition of these substances: they consist essentially of acids and neutral bodies, and their 'acid value' is one of the criteria applied to them. Some of them are phenanthrene derivatives, as, for example, pimanthrene from copal and retene from rosin, and a good deal is beginning to be established about the constitution of the resin acids. It is believed that in the tree they are built up by condensation of isoprene, which is now considered to be the basic building stone of so many plant products—the terpenes, rubber, carotene. In the past the chemist has studiously avoided in the laboratory all those reactions which led to the formation of resins, but the march of industry is forcing him both to study them and even to seek to imitate the tree in making them synthetically. Of course, the chief characteristic of the resins is that they are colloids,

and their diverse applications in the industrial arts are in virtue of this property.

The book makes no attempt to indicate, other than very briefly, the use of the resins, either individually or collectively. E. F. A.

(1) *Proceedings of the Second International Congress for Sex Research, London, 1930.* Edited by A. W. Greenwood. Pp. xi + 637 + 33 plates. (Edinburgh and London: Oliver and Boyd, 1931.) 21*s*. net.

(2) *The Conquest of Old Age: Methods to Effect Rejuvenation and to Increase Functional Activity.* By Dr. Peter Schmidt. Translated by Eden and Cedar Paul. Pp. xvii + 319 + 40 plates. (London: George Routledge and Sons, Ltd., 1931.) 21*s*. net.

(1) THE Second International Congress for Sex Research was held in London in 1930, when more than 250 members from about thirty different countries were present. Nearly all the papers delivered have now been published in the proceedings of the Congress. The editor has arranged them in five sections, biology, hormones, therapy, contraception and sociology. The majority of the papers deal with the physiology and biochemistry of the sex hormones and afford an excellent summary of recent work on this subject, since they are given *in extenso* with figures and tables, instead of in abstract as is more usual in the published reports of congresses.

(2) The other volume before us deals with only a small corner of the field of sex research, namely, the problem of rejuvenating the organism by stimulation of the internal secretion of the sex glands or by provision of this secretion from an external source. The author devotes a certain amount of space to refuting the criticisms which have been levied against the grafting of sex glands or the operation of vaso-ligature and also to attacking his critics. Perusal of the numerous case histories quoted shows the difficulty of maintaining a critical attitude in the evaluation of the results of the operations. It must, however, be remembered that all the functions of the body, and not the sexual alone, on which the emphasis is sometimes laid, are stated to be rejuvenated: thus digestion is improved, intellect functions more sharply and movements are brisker.

Both these volumes may be studied by those interested in the effects produced on the body by the most recently isolated hormones and in the therapeutic possibilities opened up by these investigations.

Archæology in England and Wales, 1914–1931. By T. D. Kendrick and C. F. C. Hawkes. Pp. xix + 371 + 30 plates. (London: Methuen and Co., Ltd., 1932.) 18*s*. net.

THIS book, the authors explain in their preface, is an enlarged English version of an article in German to be published under the auspices of the Romisch-Germanische Kommission of the Deutsche Archäoligisches Institut. Chapters have been added which deal with Roman and Anglo-Saxon antiquities.

The preparation and publication of this version was a happy thought, upon which archæologists will congratulate the authors, and for which they will be duly grateful. A critical survey such as this is useful as a reminder of how much fresh evidence has accrued during the last seventeen eventful years—and the amount is indeed considerable—and it serves to stimulate research by bringing into relief points upon which further evidence is required before anything approaching certainty in conclusion is attainable. For confirmation we need only refer to Mr. Kendrick's admirably impartial summary of the evidence available, at the time of writing, which relates to the earliest stone age industries in England. On the other hand, the considerable advances that have been made may be gauged—to take one example only—from the chapter on the 'Henge' monuments.

Of the twelve chapters into which the book is divided, Mr. Kendrick is responsible for Chaps. i–viii and Chap. xii, while Mr. Hawkes has written Chaps. ix–xi. The numerous illustrations have been chosen with sound judgment and a discrimination which has kept in view the needs of the text.

Astronomy. By Dr. F. R. Moulton. Pp. xxiii + 549. (New York: The Macmillan Co., 1931.) 18*s*. net.

THIS is an elementary textbook suitable for a general introductory course in descriptive astronomy, and differs from most books of a similar nature in the order of development of its subject and in its balance of emphasis. After introductory chapters on the constellations and telescopes, the earth is considered as an astronomical body. Its nature, motions, and problems connected with time, occupy three chapters, leading naturally to a consideration of the various bodies and phenomena of the solar system. All this occupies the greater portion (400 pages) of the book, and questions relating to sidereal astronomy or astrophysics (apart from solar physics) are relegated to the last two chapters.

The brevity and necessary condensation in the final section leads occasionally to an unfortunate obscurity of style. It also, however, allows other questions to be dealt with more fully than is usual in elementary textbooks; the chapters on gravitation and the evolution of the solar system, as well as parts of the final chapter on sidereal structure, being specially noteworthy in this respect. Nothing of fundamental importance is omitted, and many of the latest advances are well described, such as the discovery of Pluto, axial rotations of stars, and the new constellation boundaries (to a rough approximation). Apart from a few errors and minor blemishes, the illustrations (including numerous reproductions of photographs) form an attractively useful feature of the book.

Bronze Age Mining Round the Aegean*

By O. DAVIES

DURING the bronze age, Greece was remarkably wealthy in gold; though the most sensational finds have been those of Mycenæ, there is little doubt from the amount that has been turned up elsewhere that the contents of the shaft-graves only represent a small portion of the gold that was at one time available. Homer still has many lines reminiscent of the riches of Mycenæ, but seems no longer to be living himself in times of such plenty, and thus many of the gold objects which he describes are said to have been of foreign workmanship. In the early iron age gold was even rarer, as is seen by the astonishment of the Greeks at the regal wealth of a man like Crœsus. One may therefore ask oneself what happened to all the gold, seeing that only some of it seems to have been laid in tombs, and it is not possible for it to be destroyed by rust. Some may have been carried off by pirates, but if we look to the history of the period of reconstruction at the beginning of the iron age, we find two figures noted for their wealth, Midas in Phrygia and Solomon in Palestine; to Solomon may have gone some of the Aegean gold, brought originally to the Levant by the sea-raiders of the twelfth century B.C. or by Phœnician traders; and it is not unlikely that Midas made a good profit by selling to the Greeks the new metal iron before they had learnt to produce it for themselves, though it is probable that he also had gold mines of his own.

It is more difficult to decide where the Aegean peoples obtained their gold. The test by chemical impurities is unsatisfactory owing to the fact that gold, unlike copper, does not have characteristic impurities which are found in one mine but not in others. All the Aegean gold which has been analysed contains a good deal of silver, in amounts varying from 8 to 25 per cent, which suggests the use of native electrum; though some of the early gold, as the early bronze age pieces from Mochlos and Leucas, is of very good colour, there is no record of pure gold having been found in analysis, and in Egypt at least it is certain that the knowledge of purifying gold did not come in until later, probably at the time of the Persian invasion, while Crœsus probably started it in Lydia. On the whole, the late bronze age gold from the Aegean varies in colour, the more massive pieces being yellower than the leaf, which suggests that some method of faking the surface by dissolving the silver was already known, though it was not practicable for thin leaf.

As to mines, Macedonia seems to have been working a little stream gold from early times, as is seen by gold slags found on various sites. Herodotus[1] mentions the gold and silver mines of Siphnos in the seventh century, which were probably at H. Sosti; I have been told that two golden eggs were found here, ready to be sent as an offering to Delphi, but as they have now been lost this story must be considered doubtful. At any rate, stone hammers have been found in and above the mine, and I found a sherd which seemed to belong to some local sixth century ware, and a number of crucibles. Bronze age sherds, however, have not been found, and there are not many relics of the later bronze age on the island, so that it is probable that gold was not worked here until the iron age and that we shall not find here the source of the gold of Crete and Mycenæ.

To some extent probably local sources, which have since been exhausted, were used in the bronze age; for example, some gold objects have been found in Arcadia, not far from the placer of Doliana. Egypt produced much gold early, and, as there was frequent contact between it and the Aegean, gold may have been one of the articles of commerce. The placers of west Anatolia, especially Lydia, were probably not tapped much before the iron age, considering their wealth and reputation in later times. It may even be that the Danube valley was supplying Greece so early; it has been claimed that some gold found in Egypt came from Transylvania owing to the presence of tellurium*; and though the inference is not certain, since telluride of gold is reported from Andros, yet as there was for a long time a trade route from Egypt and Syria to the Danube, such a source is by no means unlikely.

The early bronze age objects of silver from Amorgos which have been analysed contain much gold and more copper than should remain in the metal after cupelling; they are probably therefore derived from native silver or a silver mineral. But a bar from Troy II and a vase from Mycenæ shaft-graves with a good deal of copper and some lead may have been cupelled badly or debased after cupellation.† The lead found is remarkably pure and almost free of silver, which makes it likely that it is derived from a mineral containing very little silver.

The Laurium mines perhaps were not opened before the seventh or sixth century; nor did they become prosperous until the discovery of the rich lower zone of mineralisation at the beginning of the fifth.[2] On Mytilene, at Argeno 1½ hours east of Molyvo, are old silver workings in which I found pieces of a black bucchero pot of the seventh or sixth century, now in the Ashmolean Museum. On Kuphonisia have been found some ancient mines for argentiferous lead with stone tools,

* From a paper read before Section H (Anthropology) of the British Association on Sept. 7.

* The antimony in this gold which was held to prove the presence of tellurium may be an early and sporadic instance of the use of stibnite for de-silvering, a technique otherwise thought to be medieval.

† *The presence of a little lead in silver is no convincing proof that cupellation had been practised; cf.* Friend and Thorneycroft, *J. Inst. Metals*, 41, 105, 1929, who do not believe that cupelling was known in Greece so late as the seventh century; only the knowledge of cupellation must precede that of liquation, which probably accounts for the large quantities of lead found in the iron age *aes rude* in Italy.

which may therefore be quite early, though the use of stone hammers is not confined to the bronze age.[3]

Other early silver mines are not known in the Aegean[4] nor is silver common early in Egypt, but there is much in Anatolia. The date of the old mines near Hector's grave in the Trojan Plain[5] is exceedingly doubtful. Balia was perhaps working early, but the mention in an alchemical author of silver from Adramyttium suggests rather a late date. Silver mines are known at Myndus, but classical writers are silent about them, and the modern name Gümüslü suggests that they are Byzantine or medieval.[6]

Farther east, there is certainly very early silver mining in Taurus at either Bulgar or Bereketli Ma'den; the Kara Öyük tablets mention the export of silver from this region in the third millennium. In Homer[7] we read of Halybe as the birthplace of silver; this seems to be located on the eastward land route from Troy along the southern shore of the Black Sea. Such data as we have would point either to the Taurus mines, reached by a road which followed the coast to perhaps the Halys mouth and then turned inland, or to the mines of argentiferous copper behind Tireboli, which are certainly Greek though it is not known how much earlier they go. Again, the story of the golden fleece in Colchis suggests early mining activity in the south-eastern corner of the Black Sea.

The copper of the early bronze age in Crete and the Cyclades seems to be almost entirely free of nickel but usually contains small quantities of lead, arsenic and antimony, while arsenic is sometimes added to colour the surface. These characteristics remain, on the whole, constant throughout the bronze age in Crete, but so far as one can judge from the scanty analyses of mainland objects, the metal contains only lead, arsenic and antimony being rare impurities.

Of the ores which have been analysed, that from Chrysokamino near Pachiammo was not tested for impurities, while that from Gavdos is incomplete but seems to contain about the right amount of antimony and arsenic. The Othrys ores have no nickel and contain little if any antimony and arsenic, though most have a small quantity of lead.

If we compare Aegean copper with that of neighbouring regions in the bronze age, we find that the Italian and Anatolian seem to correspond most closely to it. Analyses of ores from these regions are rare; that from Boccheggiano seems to contain rather too much silver, bismuth and nickel but otherwise agrees fairly well. The ore from Sacili in Macedonia is very similar to Aegean copper, but the mine is small, and I do not think it possible that it can have supplied the whole Aegean for fifteen hundred years; Othrys might also suit. On the whole, the analyses seem to show a constant source for copper in Crete throughout the bronze age, though the mainland copper is more variable and occasionally contains nickel. We shall see that it is probable that the mainlanders exploited a number of local mines of small importance, so that the compositions of their metal are likely to vary considerably.

To turn to the sites of mines known, I have found in the early bronze age stratum at Volo some copper slag, which I have described elsewhere. The numerous copper mines of Othrys were being worked in Hellenistic times, and for most of them there is no earlier evidence, while prehistoric sites in this area are infrequent; but some bronze double axes and celts were found in a mine at Gardiki[8]. Further, the hoard of ingots shipwrecked at Cyme might suggest the transport of copper from the mines of Othrys to southern Greece rather than the other way, it being by no means certain that these quadrangular ingots come from Cyprus. But it is difficult to say how important Othrys was in prehistoric times as a centre for copper production.

There is a persistent tradition in the ancient authors of a mine of copper and iron at Chalcis, and of an early metal industry there. One can scarcely believe that these stories are a mere invention due to the name of the town, though modern travellers have been unable to locate the mine. I have searched the territory of Chalcis thoroughly, without success; but the most likely locality is in the serpentine ridge just behind the town, which is now partly built over, and in which the mines would have soon been inundated if they had reached any depth. I have found stray pieces of copper slag to the south-east of the town; but the fact that no slag heaps of any size are known makes it probable that the mine was small and only working for a short period.

At Athens I have found pieces of copper slag on the slopes of the Acropolis, with a fragment of crucible which is perhaps early or middle bronze age. This probably comes from the working of some very small deposit; for example, malachite is reported at Colonus and on Ardettus, but the extent of the modern town makes adequate exploration of these sites now impossible.

At Mycenæ, apparently in late bronze age levels, copper slag has been found, and there is in the Athens Museum a tray of malachite galena and sulphur, which was found during Tsoundas' excavations here; unfortunately, it is not recorded where he found it. On both sides of the pass from Mycenæ to Phlius is a little copper ore; I could not find signs of ancient working, but a small opencast might easily be denuded completely or a shaft be filled in. Just above the deposit is a site with rough sherds which looked like early iron age ware. Other mines are reported behind Mycenæ; on the path to the Heraeum are several caves, one of which seemed to have been cut out with a pick, though whether as a mine or shelter I could not tell, while in another was a slight stain of malachite in the conglomerate. This information is at present unsatisfactory, but it is not unlikely that Mycenæ was an important centre of copper working during part of the bronze age.

On Seriphos there is much copper slag and a number of galleries in the iron mine which may have been seeking veins of copper; such rejection of the iron ore might point to early working, though there is some evidence that mining was being practised here in the later centuries B.C.

On Paros, copper slag was found in an early bronze age tomb at Abyssos. Near Naussa is a small mine of malachite, much overgrown, with a gallery leading off at each end; all the ore had been removed, as is usual in prehistoric mines; but otherwise the evidence for its early date is weak.

On the early bronze age acropolis of Syra a piece of copper slag was found.

The cave of Chrysokamino has yielded early and middle bronze age pottery, and was probably a copper mine, though all the ore has been extracted; slag, burnt clay and pieces of perforated crucible have been found outside. Gournia nearby was probably a manufacturing centre, considering how many moulds it contained, but Chrysokamino is too small to have supplied the whole of Crete with copper during the bronze age.

The copper mines of western Crete which are claimed as prehistoric were opened in Hellenistic times and continued until the Middle Ages. Much copper ore is also reported from Gavdos, but there is no reliable information as to when it was worked.

As to more distant sources, the direct evidence for bronze age mining in Cyprus is not strong, and it must be considered doubtful if the island supplied copper to the Aegean so early. The mines of Sinai are doubtful, the ore being apparently always poor, and it is likely that such copper as was produced was largely absorbed by the Bedouins, save at the times of Egyptian expeditions. The Kara Öyük tablets mention copper as an object of trade, but it is not common in western Anatolia. Italy seems to have been working copper sporadically from early times, and the Homeric Temesa is probably to be sought in this direction, whether Etruscan or south Italian ores were used. Largely, however, the Greeks seem to have used small local deposits which they completely exhausted.

[1] Herodotus, 3, 57; *cf.* Bent, *J. Hellenic Studies*, 6, 195.

[2] Cf. Ardaillon, "Le Laurium"; also Davies, *Man*, 6, 1931.

[3] Stephanos, *Cong. int. Archéologie*, I, Athens, 216; 1905.

[4] For Siphnos see above.

[5] Freise, *Z. Berg. Hütten, und Salinenwesen im preuss. Staat*, 56, 347; 1908.

[6] Paton and Myres, *Geog. J.*, 9, 38; 1897.

[7] "Iliad", ii, 856.

[8] Bosanquet, *Rep. Brit. Ass. Adv. Sci.*, 722, 1904. Athens Nat. Mus., Inventory No. 12445.

Electrical and Magnetic Units

THE British Association has done a great service to the electrical industry by fostering the study of electrical standards and it was with considerable interest that Section A listened to two papers given by Sir Richard Glazebrook at the recent York meeting. Sir Richard has been an active member of the British Association committee on electrical standards which has laboured for a period of fifty years. In 1913 a single volume edited by Sir Frank Smith was published, giving the complete series of thirty-nine reports. Sir Richard was present at the York meeting in 1881 when Section A met at the same centre—St. Peter's School—and received the eighth interim report of the committee for constructing and issuing practical standards for use in electrical measurements. One of the papers* presented by him at the recent meeting showed the changes which have taken place in the British Association wire resistance coils over the period of half a century. The conclusion reached is that platinum is the most stable material to use for the construction of standard coils. This paper has already been referred to in NATURE (Oct. 22, 1932) and will be published in full in the Report of the British Association for 1932. The other paper† dealt with a topic which is still under discussion, namely, the definition of electric and magnetic units.

Sir Richard Glazebrook is president of the Commission of the International Union of Pure and Applied Physics which was set up by the General Assembly at Brussels in 1931 to consider the symbols, units and nomenclature used in physics.

The Commission at its first meeting decided that the most urgent problem awaiting solution was the definition of electrical and magnetic magnitudes. The first step taken therefore was to prepare a questionnaire which was circulated to the national committees working under the auspices of the Union of Physics in various countries.

The principal issues raised by this questionnaire related to:

(1) The basis on which a connected account of electromagnetic phenomena should rest. Should the starting point be Coulomb's law of force between magnetic poles or some other physical law?

(2) Should μ (the permeability) be treated as a quantity having dimensions in length, mass and time, or as a pure number? In other words, are H, the strength of a magnetic field, and B, the magnetic induction, quantities having different dimensions or are they quantities of the same kind?

The British reply to this questionnaire was agreed to at a meeting held in the rooms of the Royal Society in May last, at which were present, besides the members of the National Committee for Physics, representatives of the British Association Committee dealing with Magnetic Units and British representatives of the International Electrotechnical Commission, which had also been dealing with this matter.

* Material Standards of Resistance: the British Association Coils, 1881–1932. By Sir Richard Glazebrook and Dr. L. Hartshorn.

† Electric and Magnetic Units. International Congress of Electricity, Paris, July, 1932. By Sir Richard Glazebrook and Dr. Ezer Griffiths.

The British view is that:
(1) Coulomb's law is acceptable as a starting point.
(2) Permeability should be regarded as a quantity having dimensions.

Meanwhile, replies to the questionnaire had been received by the Commission from national committees abroad and from individuals; many of the latter submitted memoranda running into fifty typed pages. To advance matters a stage further it was decided to take advantage of the presence in Paris of a number of experts attending the Electrical Congress, to call an informal conference. This conference was attended by: Sir Richard Glazebrook (chairman), Prof. Wilberforce, Dr. Ezer Griffiths (secretary), all of Great Britain; Profs. Abraham (secretary of the Union of Physics), Fabry, Paul Janet, Brylinski, Cotton, P. Bunet, Lienard (France); Prof. Verschaffelt (Belgium); Profs. van Staveren and van de Well (Holland); Prof. Wallot (Germany); Prof. Lombardi (Italy); Prof. Bjerknes (Norway); Profs. Kennelly and Pender, and Dr. Curtis (United States).

The conference had before it a summary of the replies received to the questionnaire and after consideration of these a series of proposals were submitted by the chairman. Some of these proposals were accepted unanimously and on others an informal vote was taken.

It was unanimously agreed that:
(1) Any system of units recommended must retain the eight internationally recognised practical units: joule, watt, coulomb, ampere, ohm, volt, farad, henry.
(2) The C.G.S. system is suitable for the physicist.
(3) A system of practical units, including the above eight quantities, can be derived from these by multiplying the C.G.S. unit by appropriate powers of 10.

One important proposition before the Conference dealt with the basis on which to build any system of magnetic units.

Should a start be made from:
(*a*) the force between two poles (coulomb).
(*b*) the force between two current-carrying elements (ampere) or
(*c*) the idea of 'flux'?

There was no decided majority in favour of any one of these. The view expressed by the British Committee was that the force between two elementary magnetic poles provides the most satisfactory basis. On the other hand, a number of French physicists were in favour of taking the force between two elements of current as the basis.

The chairman explained the system formulated by Maxwell, but with the proviso that μ_0 and K_0 are both quantities having dimensions.

MAXWELL'S SYSTEM

$$\text{Force} = \frac{ee'}{K_0 r^2} \quad \cdots \quad \cdots \quad (1)$$

$$\text{Force} = \frac{mm'}{\mu_0 r^2} \quad \cdots \quad \cdots \quad (2)$$

$$\text{Force} = \frac{m\, i \sin\theta\, ds}{A\, r^2} \qquad (3)$$

$$\text{Where } \frac{A^2}{\mu_0 K_0} = (\text{Velocity})^2$$

This velocity is shown by experiment to be the velocity of electromagnetic waves. Also A is a constant for all media. Maxwell puts $A = 1$ and alternatively:

$K_0 = 1$ Electrostatic system.
$\mu_0 = 1$ Electromagnetic „

In a vacuum we are to have

$$F = mm'/\mu_0 r^2$$

and in any other non-magnetic medium

$$F = mm'/\mu_1 r^2$$

where μ_1 is characteristic of the medium.

For such media we have for the magnetic induction B_0 or B_1

$$B_0 = \mu_0 H. \qquad B_1 = \mu_1 H.$$

where H is the strength of the magnetic field.

$$\text{Hence } B_1 = \frac{\mu_1}{\mu_0} B_0 = \mu B_0$$

where μ is the specific permeability: a non-dimensional quantity given by the ratio μ_1/μ_0.

In a magnetic medium we have $B_1 = \mu_1 H$ but in this case μ_1 is no longer a constant; its value is given by $\mu_0 (1 + \frac{4\pi I}{\mu_0 H})$, where I is the intensity of magnetisation and H is the field strength measured by the force on a unit pole placed at the centre of a long narrow tunnel-shaped cylinder with its axis parallel to the lines of magnetisation.

The alternative (*b*) is referred to as the *electrodynamic system*; in this, following Ampère's equations, (2) and of (3) of Maxwell's system referred to above are replaced by

$$\text{Force} = i'ds' \int \frac{[r\, i \sin^r\theta\, ds]}{r^2}$$

or possibly

$$\text{Force} = \mu_0\, i'ds' \int \frac{[r\, i \sin^r\theta\, ds]}{r^2}$$

Each equation represents the force on an element $i'ds'$ due to a closed circuit of which ds is an element carrying a current i. The expression in the brackets represents a vector in a plane perpendicular to r and ds and these vectors are to be compounded vectorially.

The other suggestion (*c*) is that a system of units should be based on magnetic flux. The space inside a hollow anchor ring over the surface of which is wound a single layer of wire carrying a current, is found by experiments with iron filings or a magnetic needle to be in a peculiar condition, and the magnetic disturbance at each point within the ring has not only a direction but also a magnitude. The disturbance is said to be in the form of flux.

Both the electrodynamic system and the system based on flux spring from a desire to avoid the

necessity of introducing the idea of an isolated magnetic pole.

Sir Richard Glazebrook in his paper to the British Association at York points out that an ammeter or a voltmeter depends for its effects on the forces between a current and a permanent magnet, whereas the object of both the systems (*b*) and (*c*) referred to above is to avoid reference to permanent magnetism. As he points out, we may measure a current by its electrolytic effects and having done so, its E.M.F. by the heat generated in a coil in a calorimeter. In practice, we have to connect the quantities so measured with the accepted units, the ampere and the volt, thus complicating our fundamental definitions with the value of the electro-chemical equivalent of silver, or, if preferred, hydrogen. He directs attention to those who object to Coulomb's law to Appendix C of the Second Report (Newcastle 1863) of the Electrical Standards Committee of the British Association. It is by Clerk Maxwell and Fleeming Jenkin and deals with the elementary relations between electrical measurements.

Those who favour the basis of the system of magnetic units as the force between the two elements of current were invited to put forward a consistent plan of a series of definitions of electrical and magnetic units.

Another topic which came up for discussion at Paris was—

"Are B and H quantities of the same kind and is their ratio μ a pure numeric ? Or should μ be treated as a dimensional quantity ?"

In submitting the point of view of the British National Committee that B and H are quantities not of the same kind, Prof. Wilberforce pointed out that B has been defined according to one method by Maxwell in the early part of his work when considering the electromagnetic system; later, when treating the possibilities of other systems, he defined B in a different manner. According to Maxwell's first method, B and H would be quantities of the same dimensions and according to his second method they would be of different dimensions. Until it can be decided what method of definition is to be adopted, it is impossible to state whether B and H are to be looked upon as quantities of the same kind. The British view is based on the more general method following Maxwell's later work. The view of the Dutch Committee is that B and H are quantities of the same kind.

In the course of the discussion, the chairman referred to the fact that he was one of the last surviving pupils of Maxwell and he felt convinced from recollections of Maxwell's teaching that he was of the opinion that B and H were quantities of a different kind. When a vote was taken, nine were in favour of treating B and H as quantities of a different nature, whilst three were in favour of regarding B and H as quantities of the same nature.

Another issue raised was whether the factor $4\pi/10$ be retained in the definition of magnetomotive force. One speaker remarked that if one omits 4π in one place it occurs elsewhere. The consensus of opinion was against its omission.

EZER GRIFFITHS.

News and Views

Sir Frank Dyson, K.B.E., F.R.S.

SIR FRANK DYSON, Astronomer Royal, will terminate his official connexion with the Royal Observatory, Greenwich, on February 28. He went to Greenwich in 1894, when he was appointed a chief assistant. After retaining this position for ten years, he was appointed Astronomer Royal for Scotland. He returned to Greenwich after six years absence, being appointed as the successor of Sir William Christie. Throughout his career, Sir Frank has taken a keen interest in all the departments of the Observatory; it may perhaps be said that his greatest interest has lain in the determination of the proper motions of the fainter stars. In company with Mr. W. G. Thackeray, he made a careful re-reduction of the catalogue of faint stars observed by Groombridge at Blackheath a century earlier; these were compared with recent Greenwich observations, providing proper motions of several thousands of faint stars. The later Greenwich catalogues have all been planned with the view of the determination of proper motions for successive zones of the sky. Sir Frank has been a keen observer of solar eclipses, obtaining successful results in 1900 (Portugal), 1901 (Sumatra), 1905 (Tunis), 1927 (England); he wrote a paper in the *Phil. Trans.* for 1906, which is still regarded as providing the standard determination of coronal wavelengths. It was also under his auspices that the expedition went to Brazil in 1919 to test the Einstein shift of starlight. Both the magnetic department and the time-service have been revolutionised in recent years; the former was moved to Abinger, as the electric railways in London were a disturbing factor. For the latter, a series of Shortt clocks in air-tight cases give very precise results; also daily comparisons with other observatories are made by wireless signals. Sir Frank has considered his successor in obtaining the provision of a new reversible transit-circle, which is nearing completion. The present circle is eighty years old, and its shutters are too narrow, not permitting free circulation of air.

Dr. H. Spencer Jones, F.R.S.

DR. HAROLD SPENCER JONES, His Majesty's Astronomer at the Cape, has been appointed Astronomer Royal in succession to Sir Frank Dyson, and will commence his duties next March. Dr. Spencer Jones is well-known at Greenwich, for he went there in 1913 and served for ten years as chief assistant. The study of optics is one of his favourite pursuits;

during the War he gave much time to testing lenses that were required for military purposes. He observed the solar eclipse of 1914 in Russia, and went to Christmas Island for that of 1922, but it was cloudy. He has been ten years at the Cape and has made a very careful study of the motions of sun, moon and planets; he has discussed the lunar elements both from the meridian observations and from occultations, of which a great number have been observed. He is also a keen spectroscopist, and has contributed many papers on Nova Pictoris, deducing its distance from the rate of expansion of the nebulous envelopes. The heliometer measures of the planets, inaugurated by Sir David Gill, have been continued, and will shortly be published. Prof. de Sitter testified, in his discussion of the satellites of Jupiter, to the value of the results obtained with that instrument. A reversible transit-circle has been in use at the Cape for many years, of somewhat similar type to the new Greenwich instrument; experience with it will doubtless be of service to Dr. Spencer Jones at Greenwich. He will also find the new Yapp reflecting telescope nearly complete.

Dr. J. Jackson

DR. J. JACKSON, chief assistant at the Royal Observatory, Greenwich, has been appointed H.M. Astronomer at the Cape Observatory in succession to Dr. H. Spencer Jones. Dr. Jackson hails from the University of Glasgow, and went to Trinity College, Cambridge, where he was a scholar from 1909 until 1914, and made researches in dynamical astronomy, particularly the perturbations of Jupiter's eighth satellite. He became chief assistant at the Royal Observatory, Greenwich, in October, 1914, where he took a considerable part in the observing activity of the Observatory. He served with the survey section of the Royal Engineers from December, 1917, to the end of the War. Attention may be directed to Dr. Jackson's work on double star orbits and the determination of hypothetical parallaxes with Mr. Furner; to the very interesting results he obtained from his study of the Shortt clocks; and to his determination of the constant of nutation from observations with the Cookson telescope. During the last seven years, he has co-operated with Dr. Knox Shaw and Mr. Robinson in the reduction of Hornsby's observations at the Radcliffe Observatory, Oxford. Quite recently he has published corrections to the orbit of Mercury for the epoch 1774–98. These results are of special importance as they confirm the motion of the perihelion of the planet, discovered by Leverrier and explained by Einstein. With Prof. F. J. M. Stratton he edited vol. 5 of the collected works of Sir George Darwin. From 1920 until 1927 he was editor of the *Observatory* magazine, and was secretary of the Royal Astronomical Society from 1923 until 1929.

Boyle Medal of the Royal Dublin Society

THE council of the Royal Dublin Society at its meeting on December 15 decided, on the recommendation of the Committee of Science and its Industrial Applications, to confer the Society's Boyle medal on Prof. Paul A. Murphy, professor of plant pathology at University College, Dublin, for his important contributions to plant pathology. Prof. Murphy's researches on the fertilisation, cytology, and life history of the potato blight (*Phytophthora infestans*), and his investigation on the infection of the new by the old crop, have been at once an important contribution to pure science, and an advance of high economic value. He early recognised the economic importance of mosaic virus, and pointed out the close connexion between the deterioration of new varieties and their infection with virus. He also established the compound nature of mosaic and recognised the fact that the disease might be transmitted by symptomless carriers. This knowledge has greatly facilitated the finding and propagating of virus-free plants. His researches have also very materially increased our knowledge and means of control of onion mildew (*Peronospora Schleideni*) and of dry rot in swedes (*Phoma lingam*).

Native Lands in Kenya

ON December 20 question was raised in the House of Commons by Sir R. Hamilton as to the situation which has arisen in Kenya in regard to native rights in the land and the leases which are to be granted by the Crown for mineral development in the new goldfield in the district of Kakamega and elsewhere. Certain amendments to the Native Lands Trust Ordinance have been embodied in a Bill which was read for a second time in the Legislative Council of Kenya on December 21. Under these amendments, it is proposed to exclude temporarily from a native reserve, land leased for mineral development, without the provision of an equivalent area of land in exchange and without the requirement of notice to the local native council concerned. Sir R. Hamilton asked whether these proposals were made with the approval of the Secretary of State for the Colonies, and further, whether the amendment of the Native Lands Trust Ordinance had been considered by the Morris-Carter Commission. In his reply, Sir P. Cunliffe-Lister stated that not only had the provisions of the Bill been agreed to both by the Morris-Carter Commission and by the Central Lands Trust Board, but that he was satisfied that the arrangements for compensation and consultation provided ample safeguards for the interests of the native occupants of the area in question.

THE Secretary of State justified his approval of the amendments on the ground that they are necessary, as an interim measure to deal with immediate practical difficulties which might operate to retard the development of valuable minerals; while provision has been made for compensation in the form of a money payment. His statement that the development of the goldfield would be for the benefit of the native was repeated by the Chief Native Commissioner when introducing the amendments in the Kenya legislature; but he candidly admitted that they would be unpopular with the natives. That admission was an understatement of the case.

If these amendments become law, of which at present there seems every prospect, the outlook is indeed grave. No limit can at present be set to the area which will be affected by the exploitation of mineral rights. Difficulties have arisen when compensation has been given for expropriated native rights in land in the form of substituted areas. The consequences of a money payment in its effect on tribal feeling and on tribal character will be serious. To divorce the native from his land, which to him is sacrosanct, is to incur the risk of causing unrest and creating a native problem no less, and possibly even more, serious than the problem of the detribalised native in South Africa. Matters should not be allowed to rest here.

Imported Books in Australia

EARLY this year (NATURE, Feb. 20 and April 2), we commented on the unfortunate effect on scientific and educational progress in Australia likely to be produced by the primage duty and sales tax on books, periodicals and magazines. We welcome, therefore, the announcement made on November 10 in the House of Representatives by Mr. Lyons, the Prime Minister, that these taxes are to be abolished (*Sydney Morning Herald*). They were introduced, with much other taxation, as part of the emergency measures necessary to meet the financial situation in Australia. A duty of 10 per cent on imported books and a sales tax of 6 per cent, together with the depreciation of Australian money, was clearly a heavy burden for scientific workers and others anxious to keep abreast of the times to bear, and an influential deputation waited upon Mr. Lyons asking for the remission of these taxes. As we pointed out at the time, and also when the Import Duties Bill proposing a duty of 10 per cent on goods imported into Great Britain was before the House of Commons, the revenue to be expected from the taxation of scientific literature in particular is negligible; such duties increase the cost of research and thereby hamper progress. Now that the budgetary position in Australia has improved to the extent that reduction of taxation can be considered, we are glad to find that the abolition of the primage duty and sales tax on literature is in the first group of measures brought forward.

Jubilee of the Basic Steel Process in France

THE basic steel process was introduced into France in 1882, and to mark the fiftieth anniversary, a special meeting of the Société des Ingénieurs Civils de France was held in Paris on December 5, the President of the Republic, M. A. Lebrun, honouring the proceedings by presiding. Four addresses were given dealing with the history of the basic process, and another on the iron ore district of Lorraine. The Iron and Steel Institute was represented by the president, Sir Charles Wright, Mr. F. W. Harbord and Mr. G. C. Lloyd, who prior to the official proceedings were received in private audience at the Palais de L'Elysée by the President of the Republic. The basic steel process which made possible the utilisation of huge deposits of hitherto practically useless phosphoric ores, was the invention of Sidney Gilchrist Thomas (1850–85) who worked at the subject while a clerk in a London police court. His first paper, written in collaboration with his cousin Percy Carlyle Gilchrist, "On the Elimination of Phosphorus in the Bessemer Converter" was to have been read at the Paris meeting of the Iron and Steel Institute in 1879, but for want of time had to be omitted. Thomas, however, was brought into contact with E. W. Richards and then J. E. Stead, and a successful demonstration of the process was made on April 4, 1879, at the Cleveland Steel Works. Thomas unfortunately did not live long to enjoy his triumph, for after travelling in search of health, he died in Paris on February 1, 1885, and was buried in the Passy cemetery.

Education and International Organisation

THE report of the Sixth Committee to the Assembly of the League of Nations on the work of the International Organisation for Intellectual Co-operation stresses the importance of the educational questions with which the International Committee has been concerned, particularly those concerned with instruction in the aims and work of the League. Inquiries on the training of primary and secondary school teachers and the efforts made to facilitate the revision of school textbooks are of the greatest importance for the development of a spirit of world citizenship and the replacement of the partisan and nationalistic teaching of history and geography by a presentation alike scientific in method and worldwide in sympathy. Links are being created between university organisations and national educational information centres, and the report stresses the advantages obtainable from a new orientation of broadcasting and the cinema, with the assistance and guidance of teachers.

EFFORTS in the field of continuation courses and adult education have continued, while the research work on international relations, of which the report on the intervention of the State in economic life at the Milan Conference last May was the outcome, is being pursued, and the results of inquiries carried out in an objective and disinterested spirit will be discussed at a further meeting of men of science. Stress was laid on the work to be done by the Press in raising the intellectual level of mankind and a resolution adopted by the Assembly requests the organisation to study the methods by which the Press might contribute to a better understanding between the peoples of the world by perfecting their knowledge. Reference is also made in the report to the successful co-operation established with the Chinese Government to facilitate the extensive schemes of educational re-organisation drawn up by the latter, and the report of the mission of educational experts sent to China, like the report presented by a representative of the Educational Cinematographic Institute, embodies ideas regarding the establishment of a system of public education which should be of value to all governments.

Calakmul, Yucatan

FURTHER particulars of the recently discovered Maya city of Calakmul, in the south of Campeche, Yucatan, dated by its sculptured monuments as belonging to the Old Empire, A.D. 364–551, have been published by the Carnegie Institution of Washington (*News Service Bulletin*, vol. 2, No. 34). The information is derived from a report by Dr. S. G. Morley on the results of an expedition of the Institution which left Washington for Calakmul in April last. Forty-one additional monuments were discovered, bringing the total number up to 103, the largest number yet found on any Central American site. The dates on 45 monuments have been deciphered. Among the more notable discoveries were the quarry from which the stone was taken with two large blocks side by side, partially quarried, just as they were left by the builders, a huge flat outcrop of limestone in which were sculptured figures of six prisoners with their arms tied behind them by ropes and a large sculptured monument portraying a priest grasping a spear in his right hand, which was erected in A.D. 472. Owing to the luxuriance of the vegetation only a single building has been left standing. A survey map of the central part of the site, the civic and religious centre, has been made. The importance of the site lies in the fact that, lying half way between the earlier cities of northern Guatemala and the later cities of northern Yucatan, it fills in a geographical 'blind-spot' and bridges the gap between the two regions. It is within four days' journey by mule from Uaxactun, the oldest city of the Maya civilisation in northern Guatemala. The foundation of the city, or at least its attainment of sufficient economic importance to permit the inhabitants to mark the five year periods by the erection of monuments, would appear to coincide with the later part of the First Period of the Old Empire, when Maya culture was expanding throughout the Yucatan peninsula.

Paintings in Ancient Palestine

A DISCOVERY of special interest at Teleilat Ghassul in Palestine is reported by the Rev. J. G. Duncan in the current issue of *Ancient Egypt* (Pt. 3, 1932). On this site, which is conjecturally identified with the ancient Sodom, three buildings, evidently not temples or palaces, but dwelling-houses, have been brought to light which date, at the latest, from 2,000 B.C., when the city was finally destroyed. In two of them the room-walls proved unexpectedly large, being 19 ft. and 20 ft. in length respectively. It was not known previously that dwellings of this size were in use in Palestine at this early stage of civilisation. What, however, was of even greater interest was the fact that these walls had been decorated with paintings, a single subject covering the whole wall, thus arguing developed artistic skill. With the exception of a cistern at Ophel, attributed doubtfully to the Byzantine age, wall paintings had not been discovered previously in ancient Palestine. The paintings, which are on plaster, have suffered from various causes, including the damp soil, which may explain the apparent absence of wall-paintings on excavated sites. It is just possible to make out the subject of two of the paintings. One is apparently a religious scene and shows several, six or seven, human figures gazing towards a shining object in front of which stands a smaller figure, facing the others; and the second is a landscape or hunting scene, in which the only well-preserved figure is a bird, painted with a master's touch. The colours, light and dark red, brown in various shades, black, yellow and white are the same as appear in the painted pottery. The site, which is being excavated by P. Mallon, is somewhat obscure in its cultural and chronological relations. It appears to be of late neolithic or early copper age date.

Exhibition of Scientific Instruments and Apparatus

A PRELIMINARY announcement of the Physical Society's twenty-third Annual Exhibition of Scientific Instruments and Apparatus which is to be held at the Imperial College, South Kensington, on January 3–5 has already appeared in these columns (Dec. 10, p. 887). Particulars are given there of the times of opening and of the times and titles of the discourses. The catalogue of the exhibition, which is used by many as a reference book during the year, has now been published, and copies may be obtained from the Exhibition Secretary, at the office of the Society, 1, Lowther Gardens, Exhibition Road, London, S.W.7 (9*d*. post free). We are glad to notice that although the name of the Optical Society no longer appears on the catalogue, since it has amalgamated with the Physical Society of London, the optical instrument trade is as well represented as in former years. The Physical Society is making an important contribution to the scientific instrument trade by the inclusion of a section for apprentices and learners at the Annual Exhibition. The catalogue shows that the exhibits in the research and experimental section will be of great interest, and that the trade section, which forms the principal part of the exhibition, will include many important new developments. The value of the exhibition is enhanced by the excellent response of those taking part in it to the desire expressed by the organising committee, that the working parts of instruments or apparatus should be exposed to view. In some instances exhibitors have provided working models. We understand that the discourses to be delivered at the exhibition will be fully illustrated by experiments, lantern slides, and cinematograph films.

Floodlighting

THE floodlighting of many of London's famous buildings last year was a great popular success. It also gave engineers a unique opportunity of studying the problem critically. In a paper on the subject which appears in the General Electric Co.'s (G.E.C.) *Journal* for November, Mr. T. E. Ritchie begins a very thorough discussion of the subject. He shows the fallacy of thinking that floodlighting is objectionable because it is 'unnatural'. The same objection might be urged against the inside lighting or the warming of a building or even against the building

itself. In many cases, however, the way in which it is done is open to severe criticism. To illustrate this he shows photographs of Thames House, Millbank, floodlighted, first when special attention is paid to the roof and skyline and secondly when they are neglected. In the first case, the effect produced is beautiful but in the second case the floodlighting is very disappointing, the building appearing dwarfed and incomplete. The floodlighting in the first case was designed by Sir Frank Baines, the architect responsible for the building, and he supervised its execution. It is also pointed out what an important part the reflection factor of the lighted portion of the front of the building plays. In floodlighting the front of the Institution of Electrical Engineers, London, for example, the aggregate total load on the 26 floodlights used is 39 kilowatts. Owing to lack of time, the front had not been steam-cleaned prior to the installation and so the average reflecting factor was only 7 per cent. If it had been steam-cleaned, the average reflecting factor would have been increased about five times and so the saving, if the same total illumination were produced, would be about four-fifths of the present current bill.

Electric Cooking on the Thermal Storage System

SINCE coal can be produced at a uniform rate and stored ready for use as required, the plant necessary for its production has only to be capable of supplying the average demand. The same is true of oil and gas but not of electricity. Therefore the size of the necessary generating plant for electricity is fixed by the maximum and not by the average demand. As a rule the maximum output is about three times the average output and so most generating stations could treble their output provided the load was evenly distributed over the day and night. As capital charges usually represent an appreciable fraction of the selling price of electricity, any new demand which tends to level the load can be supplied economically at a reduced tariff. In thermal storage systems for heating buildings or for supplying hot water, use is made of this principle by supplying heat to the storage water at times of light load at a much reduced rate. In the case of electric 'cookers' using thermal storage, the problem is more difficult as the temperature required for cooking is much higher and the cost limits the use of too much thermal insulation. In an article on storage cookers in the General Electric Co.'s *Journal* for November, O. W. Humphreys and Dr. E. C. Walton describe different types of these devices used in America and various Continental countries as well as the 'magnet storage cooker'. Compared with the standard type of electric cooker, the latter has the following advantages. The cost of installation is very low as it is merely the cost of an extra lighting point in the house circuit. The cost of maintenance is also very low compared with the ordinary cooker, and no meter is required. When the electric supply is sufficiently cheap these cookers might well be used. Some are already in use in the Midlands in the homes of working-class people.

Research in Plant Industry in Australia

THE fifth annual report of the Australian Council for Scientific and Industrial Research shows that results of great economic value, far exceeding the total expenditure of the Council, have been achieved. Problems relating to the control of disease form one of the chief lines of investigation undertaken by the division of plant industry, and such outstanding success has been obtained in the control of bunchy top disease in bananas that it has led to the re-establishment of the crop on large areas. The heavy annual loss hitherto sustained from the development of bitter pit in exported apples should now be reduced to negligible proportions, since its relation to immaturity at picking time has been established. An additional activity of this division is the introduction from abroad of new varieties of plants likely to be of value, particularly in the drier districts. Following the success with which weed pests, such as St. John's wort, have been suppressed, the entomological division is extending the method of biological control to other noxious plants, and an appropriate insect for destroying the Noogoora burr having been recently discovered, on the completion of laboratory trials this fly will be liberated in the infested districts. The recently formed Division of Forest Products has carried out particularly valuable work on the seasoning of hard woods for the manufacture of cases, and has further devised a rapid and cheap method for treating wood to be used for butter boxes so as to avoid the development of taint, but although attention has been given mainly to problems of immediate importance, fundamental research has not been neglected.

Weeds of Grassland

IN spite of the increased attention paid to grassland farming in recent years, there is still a vast area of permanent grass of poor quality, and since the reduction of weeds is intimately associated with the best means for securing its improvement, the issue by the Ministry of Agriculture of "Weeds of Grassland" (prepared by H. C. Long, and published by H.M. Stationery Office, price 5*s*. net), should prove of great value. At the outset, emphasis is laid on the necessity for using clean seed when sowing land down to grass, as injurious weeds are readily introduced, and instances of the special dangers in the case of the rye-grasses and clovers are cited. The principles in eradicating weeds from grassland are those which make for general improvement in the herbage, and in many cases attention to drainage, manuring, grazing, etc., rather than direct methods of destruction (though spraying is considered), will lead to the eradication of undesirable species. A large number of the worst weeds that occur on grassland are dealt with individually, classification being made according to the natural orders to which they belong. A short botanical description, in which technical terms are so far as possible avoided, coupled with 92 illustrations (18 of which are coloured) from seeding to fruiting stages, renders identification a comparatively simple matter, and points of interest such as the association

of a weed with certain soil conditions, its possession of poisonous or other special properties, as well as the best methods for its eradication, are given in each case.

Salad Crops

THE growing of salad crops has become a highly specialised business in several parts of England and there seems no reason why the acreage devoted to this branch of horticulture should not be profitably extended. As an aid to growers, whether on a large or small scale, the Ministry of Agriculture has issued an illustrated bulletin (No. 55, H.M. Stationery Office, 1*s.* 6*d.* net), from which it is evident that with good management it is possible to have supplies for the market throughout the whole year. Lettuce is quite the most important crop that is included under the term salad, and the best methods for its cultivation in the field, in heated and unheated glass-houses or in frames, are described in detail. Some account is given of the varying methods adopted in different districts and the varieties found to be most satisfactory in each locality, while cultural methods in use in other countries such as America and France are also included. Watercress is another important crop grown for salad purposes. Although little difficulty is experienced in its cultivation, it is essential that the water in which it is grown should be of the highest quality as the industry has suffered considerable harm from cress grown in contaminated streams. Attention to local conditions and markets, and the choice of a suitable variety to meet these requirements, are also needed if the cress-growing is to prove a thoroughly profitable undertaking.

Forest Flora of Syria

AN expedition under the leadership of Dr. Alexander Eig, head of the Section of Systematic Botany and Ecology at the Hebrew University, Jerusalem, has been examining the forest and other flora of Syria (Science Service, Washington, D.C.). During the tour, the members of the expedition were able to collect valuable material for the herbarium as well as to complete plans for the Syrian Section of the new Botanical Garden at Mount Scopus. The party travelled twice throughout the length and three times across the width of Syria, and were able to fix in a preliminary fashion the line of demarcation between the Mediterranean zone and that of the Urano-Turanic region, the precise boundary between which was previously unknown. An important part of the expedition's work was a study of the forest species of Syria, and the investigations undertaken enabled the principal types of forest species, particularly in the Amanus and Cossus hill regions, to be determined. A study thus begun came to the knowledge of the French Governor of Jebel Druze. The expedition received great assistance from the French Government officials in the mandated territory north of the Sykes-Picot line, and the French Governor has asked Dr. Alexander Eig to advise on the subject of afforesting certain parts of the Jebel Druze region. The determination of the principal Syrian forest types will be, it is said, of considerable importance to the Botanical Garden on Mount Scopus.

Revision of Ordnance Plans

THE methods adopted in the field revision of the large-scale Ordnance Survey Plans, with some account of earlier methods, are described and explained in detail in a pamphlet by Capt. J. C. T. Willis ("An Outline of the History and Revision of the 25-inch Ordnance Survey Plans". H.M. Stationery Office. 2*s.* 6*d.*). The revision in the field is carried out by methods of prolongation and intersection but new detail must be 'hung' on to the original survey and not on to matter added at a previous revision. The use of specially selected points on the original survey has been abandoned and the equal reliability of all the original detail is accepted. The newest development adopted to counteract the liability of errors in redrawing the revised sheet entails the use of 'coated' paper at that stage. This paper permits all old detail to be expunged chemically, without affecting the surface of the paper beneath. Then it is found possible to avoid the redrawing of old detail, which involves a saving in accuracy as well as in time. A method of partial revision has had to be adopted in the centres of town and cities on the ground of economy. This neglects minor alterations in back premises while concentrating on the alignment and position of street fronts. The pamphlet contains a number of practical examples of revision, illustrated by charts, and discusses the kind of errors the surveyor may make.

Weather Maps showing Typical Distributions of Pressure

A PAMPHLET has been produced (Air Ministry: Meteorological Office. Examples of Weather Maps showing Typical Distributions of Pressure. (M.O. 237, second edition.) Pp. 8. (London: H.M. Stationery Office, 1932.) 3*d.* net.) to meet the needs of those schools where another publication prepared by the authority of the Meteorological Committee entitled "The Weather Map", which forms an introduction to modern meteorology, is used as a textbook for the teaching of elementary meteorology. The latter work appeared a little more than two years ago (see NATURE, 126, 755, Nov. 15; 1930). Being a comparatively expensive production (price 3*s.* net, compared with 3*d.* net in the case of the pamphlet under notice), it was regarded as unsuitable for distribution to individual pupils and accordingly six of the most important illustrative synoptic weather charts have here been selected from it so that pupils would be able with the pamphlet in front of them to follow the explanations of a teacher using "The Weather Map" as a textbook. The six figures selected are those numbered 9, 18, 21, 22, 23 and 24 in the textbook, and give typical examples of a depression, anticyclone, secondary depression, V-shaped depression, wedge and col. There is no explanatory matter beyond a paragraph describing the weather corresponding with the various letters that appear on the map (the Beaufort weather notation is used), the method of showing the speed and direction of the wind, the temperature, and—by means of isobars for 4 millibar steps—the distribution of pressure. The two publications, both

of which are to be obtained from H.M. Stationery Office, should, if used generally at schools, put young students on very familiar terms with the weather maps appearing in many of the leading newspapers, and at the same time give some idea of the methods of working of the official forecasters.

Atlantic Ice

THE work of the United States ice patrol on the Atlantic shipping routes during 1931 (International Ice Observation and Ice Patrol Service, 1931. Coast Guard Bulletin, No. 21) records a most unusual year. The normal number of icebergs coming south of lat. 48° N. during the year is 419; this is the mean of thirty-two year's records. During 1931 only 13 icebergs came so far south and ten of these were in May, which is the month of widest spread ice distribution on the Grand Banks. March showed two bergs and April one south of the 48th parallel. There is only one record of another year so free from ice—in 1924 only eleven bergs were recorded. These figures may be contrasted with more than a thousand in 1929, 1912, and 1909. The report contains the usual chart of the distribution of ice on the routes frequented by shipping and also the records of oceanographical observations. An interesting appendix gives an account of the ice observations made in the polar seas during the cruise of the *Graf Zeppelin* in July 1931 over the Barents and Kara Seas.

The North-East Passage

RUSSIAN newspapers have announced that an expedition on the ice-breaker *Sibirjakov*, under the leadership of Prof. Schmidt, has succeeded in navigating the whole length of the North-East Passage, from the White Sea to Vladivostok. The most dangerous section was found near the North Land, which the expedition rounded on the northern side, where it was necessary to blow up the ice in order to make any progress. The mouth of the Lena was reached in less than a month after leaving Archangelsk, but great difficulties were encountered between the mouth of Kolyma and the Bering Strait. Here the ice was three to four metres thick and all the blades of the ship's screw were broken one after another. After six days of strenuous work the ship's stern was raised above water by shifting the coal and the necessary repairs made, but when the expedition was only ninety kilometres from the Bering Strait, the screw was lost altogether, since the main axle broke, so that the remainder of the journey had to be made under sail.

Memorial to Dr. R. Stenhouse Williams

THE National Institute for Research in Dairying, University of Reading, has recently issued an appeal for funds to provide an appropriate memorial to the late Dr. R. Stenhouse Williams, first director of the Institute, who died on February 2, 1932. It has been decided to devote the fund chiefly to the further development of the Institute, to which Dr. Williams devoted all his energies. The signatories to the appeal, who represent dairy science in all its aspects, consider that this application of the fund will form a lasting monument to Dr. Stenhouse Williams. A small permanent memorial will also be erected within the Institute. Further information can be obtained from Mr. S. R. Whitley, "Rookwood", Shinfield, Reading.

M. Santos Dumont

ON December 21, the State funeral of Santos Dumont, the Brazilian pioneer of aviation, took place in Rio Janeiro. His death occurred on July 23 at São Paulo, and owing to the disturbed state of the country he was first interred there. On December 18, after the body had lain in state in the crypt of the Cathedral of São Paulo for some time, it was removed to the capital, where on arrival it was met by an escort of military and naval aircraft which performed evolutions during the transit from the station to the Cathedral of Rio Janeiro. The public were afterwards admitted to pay their last respects to one who is proclaimed by his country as the father of aviation, and on December 21 the final rites took place at the St. John the Baptist cemetery.

Announcements

MR. H. T. TIZARD, Rector of the Imperial College of Science and Technology, has been appointed chairman of the Aeronautical Research Committee in succession to Sir Richard Glazebrook.

THE Government of Ecuador has awarded the decoration of Al Merito, in the degree of Gran Oficial, to Dr. George Sheppard, State geologist to the Republic of Ecuador, in recognition of his valuable work in a consulting capacity to various departments of the Government, and also in appreciation of his published contributions to geological science during the past few years.

THE annual report of the Rockefeller Foundation for 1931 details the activities of the Foundation, of its grants in aid in various domains of human knowledge, scientific and humanistic, with brief reviews of the chief researches carried out under its endowment. Much work has been done on yellow fever, including trials of preventive vaccination. Under malaria, the existence of two races of *Anopheles maculipennis*, the chief mosquito-carrier in southern Europe, is described, one with barred, the other with dappled eggs, the former predominating in the non-malarious districts. The disbursements of the Foundation during the year amounted to 17,477,225 dollars.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A public analyst for the Metropolitan Borough of Fulham—The Town Clerk, Town Hall, Fulham, S.W.6 (Jan. 4). A principal of the Newport Technical College and Institute—The Director of Education, Education Offices, Charles Street, Newport, Mon. (Jan. 14). A University professor of civil engineering at the Imperial College (City and Guilds College) —The Academic Registrar, University of London, S.W.7 (Feb. 17).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Glycogen in Cartilage

IN 1923 Robison[1] showed that when bones of rachitic rats were immersed in solutions of calcium hexose-monophosphate or glycerophosphate, a dense deposit of calcium was formed in the matrix of the hypertrophic cartilage at the site where calcium would have occurred *in vivo* if the rats had been fed on a normal diet. He showed that the deposition of soluble calcium salts as an insoluble phosphate of calcium was due to the activity of an enzyme, phosphatase, which he was able to separate from bone.

FIG. 1.—Untouched microphotograph of section through mandible and Meckel's cartilage in a human embryo of about 72 days. Stained with Best's carmine.
C.C.=senescent calcified cartilage of Meckel with 'hypertrophied' cells laden with glycogen.
O.T.=Osteogenic fibrous tissue in which osteoblasts are differentiating with discrete particles of glycogen.
B.=Lamella of membrane bone with osteoblasts serially arranged on the free surfaces.

Fell grew the isolated femora of six-day chick embryos *in vitro* and with Robison[2] proved that the enzyme is formed by or in the hypertrophic cells of the cartilage.

Phosphatases have been found not only in actively growing limb bones but also in other tissues of the body though these phosphatases are not all of the same type. They are normal constituents of the blood, occurring both in the corpuscles and in the plasma. Both corpuscles and plasma also contain hydrolysable phosphoric esters (Robison,[3] Kay[4]). Kay published a method for estimating the activity of the phosphatase in the blood plasma. He measured the number of milligrams of inorganic phosphate liberated from excess of sodium glycerophosphate in 48 hours at 38°C. and *p*H 7·6 by 1 c.c. of plasma. In the normal adult the average value is 0·15 mgm. Numerous papers dealing with the quantitative distribution of phosphatase have appeared. There is general agreement that in cases of generalised bone disease the phosphatase activity of the blood plasma is increased even to twenty times the normal, and that the increase is proportional to the severity of the disease. Robison and Kay have thus extended the fundamental problem of deposition of calcium and bone from an elusive inorganic reaction to a carefully balanced reaction involving inorganic radicles in combination with organic molecules as in the phosphoric esters, and controlled by an enzyme, phosphatase, which seems to be specific, within limits, in its action and subject to quantitative estimation.

Harden and Young[5] and, later, Robison had emphasised the part played by phosphatase in the fermentation of yeast in relation to a deposit account of glycogen and a circulating account of hexose-phosphoric esters. Meyerhof[6] and Embden[7] later depicted the metabolism of muscle in terms of glycogen, hexose phosphoric esters and a muscle phosphatase as distinct from the earlier conception of the breaking down of glycogen to glucose and lactic acid. They showed that only about one-fifth of the lactic acid formed in the process of contraction of muscle is oxidised directly to carbon dioxide, the remainder being retransformed through hexose-phosphate to glucose and glycogen in the presence of oxygen.

In view of the known facts with regard to the distribution of glycogen in association with the hexose-phosphoric esters and phosphatase both in yeast and in the muscle cell, it immediately occurred to me that the hypertrophic cells of cartilage should be examined for glycogen in the hope that the chemical system in the ossification process would bear some relation to that already described for cells so widely different as the yeast cell and the muscle cell. Accordingly human embryos and the embryos of various laboratory animals were examined for glycogen. The tissues were fixed in Allen's modification of Bouin's fluid, sectioned in paraffin and stained with Best's carmine. Control sections were spat upon to digest any glycogen on the section previous to staining. It was found that cartilage cells in the neighbourhood of the epiphysis store glycogen in direct proportion to their age. This is true not only of the cartilage cells arranged in columns at the epiphysial line but also of cartilage cells in relation to primary and secondary centres of ossification. Thus the cartilage cell in an avascular area exhibits its vegetative characteristics in the manner of storing glycogen. The more senescent the cell the greater the storage of glycogen. The osteoblasts and highly vascularised bone contain no glycogen. It is suggested that the senescent or hypertrophic cartilage cells provide both the phosphatase enzyme and the glycogen; the latter on hydrolysis yields hexose-phosphoric esters which under the action of the phosphatase and the calcium of the circulating body fluids lead to the deposition of an insoluble phosphate of calcium in the matrix.

In view of the atypical features attributed to Meckel's cartilage, sections of the lower jaw in a human embryo of 10 weeks were examined (Fig. 1). At this stage Meckel's cartilage consists of nothing but senescent cells heavily charged with glycogen. At the proximal end of the cartilage is a mass of osteogenic fibrous tissue in which early differentiation of the osteoblasts can be seen. The glycogen is distributed in the form of discrete fine dots of about 2μ in diameter. Adjoining this is seen the first

lamella of membrane bone with osteoblasts serially arranged along its free surfaces. Both the ground substance of the bone and the osteoblasts are devoid of glycogen.

Numerous examples are found in plant physiology and animal pathology of the manner in which new cells and tissues are able to live and multiply on the autolytic products of senescent and dying cells. This is a feature of new tissue in pathological inflammation no less than of the growing shoot in tubers such as the potato. It is suggested that the vegetative proliferating cartilage in the senescent stage provides at the site of future ossification both the store of glycogen for the production of the hexose moiety of the hexose-phosphoric ester and the active enzyme, the phosphatase of Robison. The circulating body fluids provide both the calcium and the phosphates which Kay has so frequently emphasised. The phosphatase leads to deposition of calcium salts in the matrix of the senescent cartilage. The osteoblast is a highly differentiated cell which appears with the irruption of those blood vessels that proceed to remove the virtually dead calcified cartilage by a process which has much in common with that seen in aseptic inflammation. The osteoblast is able to control the deposition and re-absorption of bone in this system, presenting many of the features of a reversible reaction. The osteoclast is a multicellular osteoblast which appears in response to an urgent demand for re-absorption of bone rather than deposition.

This preliminary note on the association of glycogen with phosphatase in the senescent cartilage cell for the purpose of bone formation may serve to focus attention on the manner in which biochemical conceptions are gradually destroying the hitherto satisfying but none the less unsatisfactory views of the mechanist in anatomy. It is interesting to note from the scant facts collated by Pryde[8] that in the unincubated egg phosphatase is absent (Kay) and also the hexose-phosphoric esters (Kay, Plimmer and Scott). Both substrate and enzyme reach a maximum by the twelfth day in the chick embryo and then steadily decrease. Glycogen is practically absent in the unincubated egg, appears about the second day and rapidly increases in parallel with the phosphatase and substrate. After the twelfth day the glycogen deposit in the liver of the chick increases rapidly. Creighton[9] in 1896 thought that "the cartilages which are destined to continue throughout life as cartilages have little or no glycogen in the fœtal period, but those which later will ossify have plenty and it usually appears in the spots which afterwards become ossification centres." Marchand[10] in 1885 said: "The increase in the size of the cartilage cells in the neighbourhood of the bone is due to the accumulation of glycogen or at least coincides with it." Needham[11] in his admirable compendium on "Chemical Embryology" says: "Nobody now accepts Creighton's views and the attribution of any special embryological importance to glycogen is superfluous. While it may be useful to know the histological distribution of glycogen in the embryo, at present little physico-chemical meaning can be attached to most of this work." It is suggested that the work of Robison, Kay and Fell does provide a physico-chemical meaning for the distribution of glycogen in areas of future bone formation. Moreover, examination of the developing tooth in the embryo displays a gradual transition from concrete accumulation of glycogen in the epithelium of the primitive dental furrow, to discrete particles of glycogen in the dentine germ and absence of glycogen in the fully differentiated ameloblast of the enamel organ. The 'vegetative' characteristics of cartilage and the rôle of vitamin D in promoting calcification therein have been emphasised repeatedly by me[12]. The association of glycogen, phosphatase, phosphoric esters and vitamin D in this 'vegetative' cartilage provides a new and fundamental approach to the processes involved in diseases of bone, joints and teeth.

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Vitamin C and Hexuronic Acid

IN connexion with experiments under the direction of Dr. L. J. Harris[1] on the rôle of the suprarenal gland in vitamin C metabolism, we have investigated the silver nitrate staining capacity of glands taken from normal and scorbutic animals. It will be recalled that long before the identity of vitamin C with hexuronic acid was postulated[2,3], Szent-Györgyi[4] noticed the presence of a reducing substance (hexuronic acid) in the suprarenal cortex, which had the characteristic property of causing deep staining in the tissues when treated with dilute silver nitrate. It occurred to us that if the identity of vitamin C and hexuronic acid were genuine, suprarenals from scorbutic animals might react negatively, or less intensely in the staining test. In view of the unspecific character of the reagent and of the possible presence of other reducing substances, we were not sanguine that a clear-cut distinction from normal glands would be observed, but in actual fact the difference is unmistakable and dramatic. After staining for 15 minutes with 0·4 per cent silver nitrate solution, glands from normal guinea pigs were deeply blackened; glands from scorbutic guinea pigs were completely unaffected.

With the whole normal gland, staining was confined to the surface on account of failure of penetration by the reagent, but when the glands were cut the whole cross-section was blackened. No differentiation between cortex and medulla, similar to that observed by Szent-Györgyi in ox suprarenals,[4] and confirmed by ourselves, was noticed, but a final decision on this point must await detailed histological examination, since the relative sizes of the two zones show considerable variation in different species.

The above evidence lends further colour to the view that hexuronic acid and vitamin C are identical, or at least that their rôles are closely interrelated. Since, however, it is well known that the suprarenals become injured not only through vitamin C deficiency but also through vitamin B deficiency and simple starvation, caution may be necessary in accepting absence of staining capacity as a specific sign of avitaminosis C. The possibility of lack of

staining substance in the suprarenal from secondary causes must be kept in mind.

In preliminary experiments on suprarenals obtained from rats fed for prolonged periods on diets completely deficient in vitamin C, we have invariably observed positive silver nitrate reactions, even when through the simultaneous absence of vitamin A or the vitamin B complex the animals had reached a state of extreme emaciation. This finding is in good agreement with the current view that the rat is capable of synthesising vitamin C.

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Calculation of the Reflectivities of Sulphide Ore Minerals

THE practical difficulties of the direct determination of the indices of refraction and absorption of the opaque ore minerals have resulted in little work in this direction being accomplished. The progress of ore microscopy, however, has established the measurement of the reflectivity for (nominally) vertically incident light, whether by visual photometry as developed by Berek[1] and Schneiderhöhn, or by a photoelectric ocular as developed by Orcel[2], as a routine process in the determination of these minerals. The figures obtained present evidence of certain regular relationships. Thus, amongst the simple sulphides, selenides and tellurides a general increase of reflectivity with increasing atomic number can be traced in such series as ZnS–CdS–HgS or PbS–PbSe–PbTe.

Amongst the more complex sulphantimonites and sulpharsenites, such as the series $x\mathrm{PbS}.y\mathrm{Sb_2S_3}$ or the Binn valley minerals $x\mathrm{PbS}.y\mathrm{As_2S_3}$, the relationships are less simple. To a first approximation, however, many of these minerals can be treated as transparent in small thicknesses, still relatively great compared with the wave-length of the light employed[3]. With this assumption an approximate refractive index n may be calculated from Fresnel's relationship

$$n = \frac{1+\sqrt{R}}{1-\sqrt{R}}$$

The value of n thus obtained is used to derive from the Lorenz-Lorentz equation

$$MR = \frac{M}{d}\,\frac{n^2-1}{n^2+2}$$

the molecular refractivity MR (usually, unfortunately, denoted by the same symbol R as is now universally adopted to denote the reflectivity). For anisotropic crystals for which R_a, R_β and R_γ are known, the value $\bar{n} = \sqrt[3]{n_a.n_\beta.n_\gamma}$ is used[4] in calculating MR. If this is done for the simple sulphides, selenides and tellurides, MR values are obtained which have the same additive relationships as the usual molecular refractivities calculated for transparent salts. Of forty-five complex opaque minerals chosen at random, the MR values calculated direct from the measured reflectivities (Schneiderhöhn-Ramdohr[5], and my own measurements with a photoelectric ocular), and those computed from the MR values of the constituent molecules showed a significant difference in only a single instance, that of klaprothite (klaprotholite), $3\mathrm{Cu_2S}.2\mathrm{Bi_2S_3}$; it may be suggested with some confidence that the value for d quoted in the literature and based on an early determination by Petersen should read, not 4·6, but 6·4, the value obtained by calculating backwards from the MR value. (I have not yet been able to examine a pure specimen of the natural mineral, but the crystalline mass obtained by the Sommerlad method[6] from the fusion of the constituents gave a value for d of 6·3.) These calculations therefore appear to be of interest from several points of view.

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Electric Charges on Rain Drops

DURING the last year we have maintained in continuous action an apparatus for recording the electric charge on individual drops of rain. A drop of rain in order to have access into the insulated receiver has first to pass through a fixed but adjustable cylindrical opening of average diameter 1·4 cm. and then through a second opening of diameter 2·4 cm. at the periphery of a rotating disc. Both openings are provided with trap arrangements so that a drop striking the sides is caught and led away. The period of rotation of the disc is so adjusted that with moderate intensity of rain a second drop may not enter into the receiver until the charge of the first has been recorded and the system earthed by an automatic device. A glass manometer of very fine bore is attached to the receiver and keeps a record of the size and number of drops.

For recording the charge given to the receiver by a drop of rain, a Wilson tilt electroscope is used very nearly at its maximum sensitiveness, and the movement of the gold leaf is photographed by allowing light from a point source (a 'Pathé-Baby' projector lamp) to pass through a minute slit and a short focus lens and fall transversely as a narrow beam of about half the breadth of the leaf over a fine pin-hole made at its lower end, which is twisted at right angles to its plane. The transmitted light through the hole gives a magnified image of its displacement on a quickly moving photographic paper. All necessary precautions were taken to avoid the influence of the field of the earth and any artificial field on the drops.

This method of recording is of particular interest in view of the fact that the Wilson tilt electroscope has not to our knowledge been used in the past as a recording instrument. Simultaneously with the above apparatus, a Simpson apparatus giving the charge of rain collected every two minutes was kept in action.

An analysis of the records shows that both positively and negatively charged drops are present in the rain received from any part of the cloud. When the rain received during any interval is positively

or negatively charged as a whole, there is an excess of positively or negatively charged drops. The following table gives the charge per drop based on the measurement of about two thousand drops. In making the tabulations all drops were neglected the charge of which was less than 0·06 e.s.u.

	Charge per drop (e.s.u.)					
	Positively charged drops.			Negatively charged drops.		
	Mean	Absolute max.	Mean max.	Mean	Absolute max.	Mean max.
Non-thunderstorm rain	0·64	1·95	1·23	0·67	2·41	1·24
Thunderstorm rain	0·69	2·44	1·82	0·73	3·74	2·26

A detailed analysis of the observations with discussion will be given in our forthcoming memoir on the subject.

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Diamagnetism of Thin Films of Bismuth

AT Prof. W. Gerlach's suggestion I have recently investigated the behaviour of the magnetic susceptibility of bismuth when measured in the form of thin films. A modified form of the Faraday method was employed, the measuring system consisting of a flat cross with four equal arms about 15 mm. long and 5 mm. wide, the arms being set at about 90° to one another. This system was constructed of glass about 0·1 mm. thick. A fine glass wire through the centre of the cross and perpendicular to its plane carried a small galvanometer mirror; the system was suspended from a torsion head by means of a fine quartz fibre and was thus free to turn about the glass wire as axis. The cross hung in an inhomogeneous, but symmetrical, magnetic field formed by two 60° wedge-shaped pole pieces such that each pole piece occupied the space between two adjacent arms of the cross. The plane of the cross was horizontal and parallel to the lines of force, the centre of the cross and field system being coincident. The gap between the pole pieces was about 10 mm. In the magnetic field the cross would take up a very definite position of equilibrium and this point was made the zero point of the system when no field was acting. A film of bismuth was now deposited on one long arm of the cross (that is, about 30 mm. long) thus upsetting the equilibrium and causing the system to be deflected, which in turn was brought back to its initial zero position by means of the torsion head, the angle of deflection being determined by a telescope and scale in the usual way.

The films were produced by evaporation from an electric furnace such that they were about the same size as one long arm of the cross, that is, about 30 mm. × 5 mm., and of very uniform thickness. The deposition of the films and measurements were made in vacuum; it was impossible however to outgas the cross system. The procedure was first to deposit a very thin sensitising film, the magnetic properties of which were negligible, in order to have a more or less definite surface on which to deposit the thicker films. A film was now deposited and the deflection measured; over this was now deposited a very much thicker film and the deflection again measured, always from the initial zero position in the same field. Of course an intermediate film between the thick and the thin one could be deposited and measured if desired. If θ, K and d refer respectively to deflection, volume susceptibility and thickness of a given film, since the field remains the same for two or more given measurements,

$$\theta \propto Kd$$

$$\text{or} \quad \frac{K_2}{K_1} = \frac{\theta_2}{\theta_1} \cdot \frac{d_1}{d_1 + d_2}$$

Hence in order to compare the susceptibility of a thin and a thick film we must know the ratio of d_1 to d_2. By means of a shutter in the apparatus the time of deposition of the films could be accurately controlled. Both films are deposited under the same conditions of temperature and pressure in the apparatus. In order to give absolute values the thickness of the final film ($d_1 + d_2$) was determined in the usual way by weighing. From the times of deposition the ratio d_1 to d_2 is known and d_1 and $d_1 + d_2$ are known absolutely. The susceptibility of the thin film is then known in terms of the thick one.

Lack of space prevents giving a detailed table of results but in some forty determinations ranging in film thickness from 0·2 μ to 15 μ no variation of the susceptibility could be found. Certainly the fluctuations between readings is rather large (some 12 per cent) but these readings are all grouped around a mean value which is quite constant. I believe we can draw the conclusion that, in the given range, the susceptibility of bismuth remains constant.

A considerable amount of work on the susceptibility of colloidal powder of bismuth and other metals (Sb, Ag, Au) has been done by Vaidyanathan,[1] Rao[2] and others. These authors find that with decreasing particle size the diamagnetic susceptibility decreases and have advanced the hypothesis that the susceptibility becomes a function of the particle size when this is less than 10 μ. While Mathur and Varma[3] in a careful series of tests have shown that a large part of this decrease in bismuth is due to oxidation, Rao[2] still finds a change when the oxide is removed as completely as possible. If, however, diamagnetism actually depends on particle size, we should expect the experiment described here to show it, since we know that a thin film is composed of small crystallites the size of which decreases as the film thickness is decreased.

I would suggest that the hypothesis recently advanced by Seemann and Kussmann[4] to explain the effect of cold work on the susceptibility of metals might also account for the effect observed in colloidal powder. The process of mechanical colloidalisation (that is, grinding) could be looked upon as cold working, which sets free ferromagnetic impurities in the metal giving rise to a decrease in diamagnetism. Melting the colloidal powder (as Rao has done) would again render the impurity inactive giving rise to an increase in diamagnetism as observed. It might be possible to make a direct check on this point by measuring the susceptibility of each powder at various field strengths, since as the particle size decreases the susceptibility should show more and more variation with the field.

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[1] Vaidyanathan, *Ind. J. Phys.*, 5, 559; 1930.
[2] Rao, *ibid.*, 6, 241; 1931.
[3] Mathur and Varma, *ibid.*, 6, 181; 1931.
[4] Seemann and Kussmann, *Naturwiss.*, 19, 309; 1931.

Velocities of Emission of α-Particles

THE relative velocities of the α-particles from thorium X, thoron, thorium A, thorium C, thorium C′ and radium C′ have been measured by the direct magnetic deflection method using a permanent magnet[1] giving a field of about 5,000 gauss. The deflections were measured with a microphotometer, and by carefully investigating possible sources of error such as loss of velocity by absorption at the source, non-uniformity of the magnetic field, and the effect of any movements of the photographic emulsion during development, it has been possible to obtain a considerable improvement in the accuracy of measurement of α-ray relative velocities.

The results for the relative velocities are shown below; the probable error is 1 in 20,000. The absolute velocities are deduced from the value $1 \cdot 922 \times 10^9$ cm. sec.$^{-1}$ for radium C′ [2].

	Relative Velocity	Absolute Velocity
Radium C′ ..	1·00000	$1 \cdot 922 \times 10^9$ cm. sec.$^{-1}$
Thorium X ..	0·86042	$1 \cdot 653_9$
Thoron ..	0·90464	$1 \cdot 738_9$
Thorium A ..	0·93935	$1 \cdot 805_4$
Thorium C ..	0·88811	$1 \cdot 707_0$
Thorium C′ ..	1·06872	$2 \cdot 054_1$

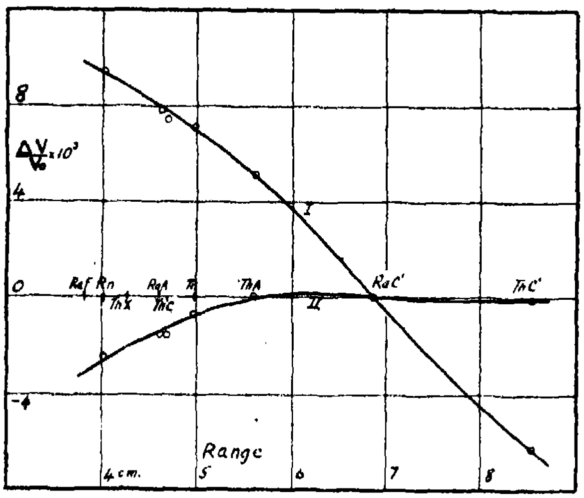

FIG. 1.—The relation between range and velocity of α-particles. Curve I, deviations from the Geiger relation $V^3 = kR$; Curve II, deviations from $V^{3 \cdot 36} = kR$.

The complexity of thorium C discovered by Rosenblum produced a slight broadening of the line but no evidence of complexity was found in the other groups. The velocity for thorium C corresponds to the weighted mean of the two main components.

The relative velocities of the α-particles from radium A, radon, and radium C′ are also being measured and the following preliminary results have been obtained:

	Velocity relative to Radium C′	Absolute Velocity
Radon	$0 \cdot 8455 \pm 0 \cdot 0003$	$1 \cdot 625 \times 10^9$ cm. sec.$^{-1}$
Radium A	$0 \cdot 8839 \pm 0 \cdot 0002$	1·699

From the velocity ratios obtained in this work and the range measurements of Lewis and Wynn-Williams[3] a new correction curve (Fig. 1, curve 1) to the Geiger relation, $V^3 = k R$, has been calculated from the equation

$$\Delta V/V_0 = V/V_0 - (R/R_0)^{\frac{1}{3}}$$

used by Rutherford, Ward and Lewis[4]. V_0 and R_0 are the velocity and range of radium C′.

It is found that the equation $V^{3 \cdot 36} = k R$ accurately expresses the relation between velocity and range above a range of 5 cm. The deviations from this relation calculated similarly are shown by curve II.

From these curves the velocities relative to radium C′ may be calculated with a maximum error of 0·0004, for other groups of α-particles the ranges of which have been measured by Lewis and Wynn-Williams.

	Velocity relative to Radium C′	Absolute Velocity
Actinon (short)	0·9179	$1 \cdot 764 \times 10^9$ cm. sec.$^{-1}$
Actinon (long)	0·9420	1·811
Actinium A	0·9795	1·883
Actinium C (short)	0·9034	1·736
Actinium C (long)	0·9282	1·784
Actinium C′	0·9841	1·891
Polonium	0·8310	1·597

There are systematic differences between the results given above for thorium C (mean), thorium C′ and radium A, and those obtained earlier by Rosenblum[5] in the course of his experiments on the fine structure of α-ray spectra using the large electromagnet of the Paris Academy of Sciences. Recently, however, Rosenblum and Dupouy[2] have measured the velocities of seven groups after having made a fresh exploration of the field of the magnet. The results agree to well within the limit of error, 0·5 to 1 in 1,000, with those reported here.

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Oct. 17.

[1] Briggs, *J. Sci. Inst.*, **9**, 5; 1932.
[2] Rosenblum and Dupouy, *C. R. Acad. Sci.*, **194**, 1919; 1932. Briggs, *Proc. Roy. Soc.*, A **118**, 549; 1928.
[3] Lewis and Wynn-Williams, *Proc. Roy. Soc.*, A **136**, 349; 1932.
[4] Rutherford, Ward and Lewis, *Proc. Roy. Soc.*, A **131**, 684; 1931.
[5] Rosenblum, *C. R. Acad. Sci.*, **190**, 1124; 1930.

Productivity of the Fisheries North and South of the Suez Canal

THE work of the great oceanographical expeditions, and the experience of the fisheries administrations in the different countries, have alike gone to show that living things are more abundant in temperate and polar seas, than in those of the tropics and subtropics.

It is a little surprising, therefore, that the fisheries of the Gulf of Suez should have the reputation of being more productive than those of the Mediterranean coast of Egypt; for, though I have shown elsewhere[1] that the Port Said end of the Suez Canal may be the hotter, this is only so for six months of the year, and even then must be regarded as a local effect, the main water masses of the northern Red Sea being always hotter and salter than the eastern Mediterranean.

That the Gulf of Suez fishery is indeed more productive, is well shown by the evidence of the Egyptian fishery statistics concerning the trawl fishery, where the mean catch in kilograms per net per day's fishing at Alexandria and Suez for the last ten years, and at Port Said for the last nine are: Alexandria, 115; Port Said, 131; Suez, 232.

In the long line fishery, a motor ketch, working in the summer of 1930 from Alexandria, and in the summer of 1931 from Suez, gave a greater yield per basket of lines at Suez, compared with Alexandria. Nevertheless, as much of the Suez catch was made up of dogfish, sharks and rays, the catch at Alexandria was sixteen times as valuable. Similarly in the trawl fishery, though elasmobranchs form only a small

part of the catch at Suez, the Red Sea fish are not esteemed as much as those of the Mediterranean, and the Alexandria catch is more valuable.

Finally, and in addition to the evidence of the commercial catch, my own observations (based on the change in hydrogen ion concentration on storing water samples, *loc. cit.*) and those of Natterer[2] show that there is more organic matter in the water of the southern than in the northern part of the Suez Canal.

The explanation of this anomaly seems to me to be a tidal one. At Suez there is a considerable ebb and flood, which is absent at Port Said. This tidal scour must cause a thorough vertical and horizontal mixing of the water mass in the head of the Gulf of Suez and the southern end of the Suez Canal. It would replenish with basic food materials areas that might otherwise have become exhausted as a result of the synthetic activities of marine algæ. On the other hand, and particularly so between February and August, when the Nile out-flow is dammed, the water of the Mediterranean coast of Egypt must be relatively stagnant, and, for such mixing as there is, will depend mainly upon the strength and direction of the wind in the coastal area. Under these conditions, one can quite easily see that in long periods of calm weather the basic food materials necessary for algal growth would be used up, and in the absence of further supplies being circulated, this growth would cease. It is, of course, upon this algal and other plant growth that the yield of the fishery ultimately depends.

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[1] "Some Hydrographic Data from the Suez Canal, 1928-1929", Fisheries Research Section, Bull. No. 1. Govt. Press, Cairo, 1930.
[2] "Berichte der Comm. für Erforschung der Östliche Mittelmeers." 1898.

Cystine and Wool Production

ATTENTION continues to be directed to the difficulty of accounting for the manner in which sheep on pastures secure the cystine necessary for wool growth. In a recent communication to NATURE,[1] Rimington and Bekker conclude that the amount of cystine consumed in the grass fails to account for the amount present in the fleece and formulate an alternative hypothesis that "The intestinal flora and fauna .... are almost certainly able to synthesise cystine from inorganic sulphur and it is conceivable that the population of the sheep's intestine, by continual increase, is transforming sulphates into cystine, built into their own protoplasm, with a high grade of efficiency. As bacteria die, their cell protoplasm autolyses, again setting free the sulphur, now in the form of cystine, which is readily available to the sheep."

Although this hypothesis is attractive, the evidence against it is considerable. Various Continental and American workers have noted that the bacterial flora of the intestine readily decompose sulphur-containing bodies and even elementary sulphur to hydrogen sulphide, ethyl mercaptan and similar compounds which, *on absorption*, are very rapidly oxidised by the blood stream and excreted as urinary sulphates. The possibility of the transformation of inorganic sulphur into cystine by such means has not been demonstrated, however. Recently, we have also studied the activity of cellulose-splitting bacteria isolated from the contents of the sheep's rumen by continuous sub-culturing in a medium containing ammonium sulphate as a source of nitrogen and sulphur. Although there was a pronounced decrease in sulphate sulphur and the formation of hydrogen sulphide, there was no evidence of the formation of cystine or any similar sulphur compound. Fraser and Roberts[2] have made the suggestion that "cystine is formed during keratinisation, and that cystine synthesis is a function of the wool follicle itself. The amount of cystine produced in a fleece would then depend upon the number and activity of the wool follicles, and not upon the cystine content of the food or the bacterial population of the intestines."

It is of the utmost importance, from the point of view of pastoral industry, that the whole problem should be brought into its proper perspective. The recent work of Evans[3] has shown that cultivated pasture, under English conditions at any rate, contains about 0·1 per cent of cystine on the basis of dry matter (*not* 0·01 per cent as is accepted as the average figure by Rimington and Bekker). Considering the case cited by these investigators, and assuming that a fully-grown sheep is able to consume daily an amount of pasturage containing 4 lb. of dry matter, it follows that the necessary 0·78 lb. of cystine in a 12 lb. fleece would be secured from the pasturage during a grazing period of 195 days. Even on the assumption that only 50 per cent of the cystine in the grass is actually retained in the animal for purposes of wool-protein synthesis, it is clear that a sheep would consume per annum roughly all the cystine necessary for the growth of a 12 lb. fleece. If, however, the average wool production per head of the sheep population in Great Britain be taken at the much lower official estimate of 5–6 lb.,[4] then the argument becomes even more convincing.

We are led to the belief, therefore, that under English conditions, there is no difficulty in accounting for wool production in sheep subsisting wholly on pasturage. The cystine content of the herbage, although apparently low, is adequate for this purpose. The previous interpretation of the figure obtained for the cystine content of grass as indicating the presence in the herbage of a cystine precursor becomes therefore superfluous.

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[1] Rimington and Bekker, NATURE, **129**, 687; 1932.
[2] Fraser and Roberts, NATURE, **130**, 473; 1932.
[3] Evans, *J. Agric. Sci.*, **21**, 806; 1931.
[4] Wool Survey of the Empire Marketing Board, 57; 1932.

Radiation and Enzyme Activity

A SYSTEMATIC study of metabolic radiation by a modified photographic method in this laboratory (to be published at a later date) has revealed the following facts: (1) Radiation is a general function of normal organic metabolism, being exhibited by blood, milk, eggs, brain, bone-marrow, lung, the pituitary (anterior and posterior lobe) and the parathyroid gland, urine, roe of plaice, yeast, Demerara sugar, honey, etc. (2) Radiation fades with the lowering and re-appears with the raising of temperature; it is inhibited at −5° to −10°, destroyed by heating at 98°–100° for two hours, inhibited by carbon monoxide in the dark but regenerated in sunlight, and destroyed by hydrogen peroxide, potassium permanganate and potassium cyanide. (3) Pure cholesterol, vitamins (C and D), sucrose, hormones and alkaloids as such are void of radiation.

Comparing the occurrence of radiation and the influences controlling it with the distribution and characteristics of respiratory enzymes, we have no difficulty in recognising radiation as an inseparable part of normal enzymatic activity (oxidase, dehydrogenase).

This deduction links two hitherto unrelated lines of research on malignant growth, namely, (*a*) Warburg's work on abnormal glycolysis by restricted activity of respiratory enzymes, and (*b*) Gesenius's investigation on inhibited radiation in relation to disease.

Excluding parasitic inhibition (syphilis, tuberculosis) and passivity caused by suppressed intake of oxygen (pernicious anæmia), the depletion of respiratory enzymes in cancerous cases may be due to enzyme starvation, for which our diet and culinary methods are mainly responsible. To restore normal metabolism in all its phases we should require the introduction of a cellular system capable of regulating glycolysis, the vitamin and hormone equilibrium, to be non-toxic and able to function under partly anærobic conditions. Yeast, especially commercial baker's yeast, in an enzyme-bearing medium (unrefined sugar, honey, etc.) which is respiratorily much more virile than any pure culture, should provide such an enzymatic association.

Local inductive and contact influences (rays, tar, etc.), affecting respiratory enzymes, become, if protracted, carcinogenic.

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Liesegang Rings

DR. HEDGES is to be congratulated on his book on "Liesegang Rings", which gives for the first time a comprehensive survey of the subject together with a most extensive bibliography. It will be a valuable work. His description of my theory is adequate, except that he is incorrect in stating that it does not account completely for all the facts. The example quoted against it is a beautiful confirmation. The formation of zones of precipitated sodium chloride is due to the oppositely diffusing solutions of hydrochloric acid and sodium chloride being constrained by the capillary tube to pass near the deposited salt. This demonstrates the essential part played by the precipitate in removing the solute from the solution in its neighbourhood.

This experiment is not the first case of so-called rhythmic precipitation without chemical reaction. In 1921[1] I described beautiful bands of tiny gelatin particles suspended in water, which were formed by diffusing alcohol into dilute solutions of gelatin. Further, my adsorption theory explains the formation of banded structures by crystallisation.[2]

Dr. Hedges proposes an alternative theory that the phenomenon requires "(1) a critical condition, which has to be reached before crystallisation, precipitation, coagulation, condensation, or other change involved in the formation of the periodic structure takes place, and (2) mobilisation of the material which can occur during the delay caused by the first condition. In this way material is moved from the zone which eventually become the spaces to those which eventually become the rings." This attempt at generalisation is too indefinite as a working hypothesis. The majority of systems included would give no periodic structures. It does not indicate the part played by the precipitate, or specify that it must be held in place. Even if the statement is made more definite by specifying supersaturation as the critical condition and diffusion as the means of mobilisation, only a very small proportion of the many systems that would conform to these conditions would produce good banded precipitates. The theory is incapable of explaining the facts in detail as my adsorption theory does.

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[1] *Biochem. J.*, 15, 561; 1921.
[2] *Biochem. J.*, 12, 360; 1918.

Carbon-Oxygen Linkage in the Metal Carbonyls

DADIEU and Kohlrausch[1] have shown that the $>C=O$ group in aldehydes, ketones and esters, is associated with a Raman displacement of 1,500–1,700 cm.$^{-1}$; Rasetti[2] found for carbon monoxide a shift of 2,155 cm.$^{-1}$, in satisfactory agreement with the structure $\overset{-}{C}\equiv\overset{+}{O}$. Observation of the Raman effect in the metal carbonyls should therefore discriminate between a co-ordinated structure[3], and any cyclic structure embodying $>C=O$ groupings.

Through the kindness of Prof. A. Fowler, I have been able to photograph the Raman spectrum of nickel carbonyl, and to find a strong line corresponding with a displacement of 2,038 cm.$^{-1}$, together with a number of diffuse lines of displacements up to 450 cm.$^{-1}$. Since the performance of this preliminary experiment, Dadieu and Schneider[4] have examined the Raman spectrum in detail, and found shifts of 2,125 and 2,039 cm.$^{-1}$, corresponding to the carbon-oxygen linkage, together with lines at 595, 456, 379 and 80 cm.$^{-1}$ which have been attributed to the fundamental frequencies of a tetrahedral molecule.

The Raman effect thus affords decisive evidence that the carbon monoxide is present in the molecules of the metal carbonyls as such, the difference between the value 2,155 cm.$^{-1}$ found for carbon monoxide itself, and the doublet 2,125 and 2,039 cm.$^{-1}$ found in the case of nickel carbonyl being attributable to the modification in the forces operative in the carbon-oxygen linkage brought about by the co-ordination of the carbon monoxide to the metal, and the consequent redistribution of polarities.

It is important to note that this evidence, as also that derived from measurement of the dipole moment[5], is in full accord with the chemical properties of the carbonyls, in particular the replaceability of the carbon monoxide by amines (cf. the formation of the compound $Ni(CO)_2.C_{10}H_8N_2$ and analogous iron and cobalt compounds[6]). The convergence of evidence may therefore be taken as establishing beyond doubt a structure of the type indicated above.

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[1] Dadieu and Kohlrausch, *Ber.*, 63, 251; 1930.
[2] F. Rasetti, NATURE, 123, 205; 1929.
[3] cf. Sidgwick, "Electronic Theory of Valency", p. 216.
[4] Dadieu and Schneider, *Akad. Anzeiger der Akad. der Wiss.*, Wien. Oct. 15, 1931.
[5] Sutton and Bentley, NATURE, 130, 314; 1932.
[6] Hieber, Mühlbauer and Ehmann, *Ber.*, 65, 1090; 1932.

Research Items

Dried Head from New Guinea.—Mr. H. G. Beazley figures and describes in *Man* for December one of the rare dried heads of the Marind-anim (Tugeri) peoples of Dutch New Guinea. Two methods of preserving the head are known from the various districts of New Guinea. In addition to the 'preserved' head method, is that in which a reconstruction of clay overlies the cranium. In the specimen described here both methods are followed. While the original skin still covers the features, the posterior portion is entirely constructed of clay. The Tugeri to-day are an inland people; but they make periodical raids down river in their canoes on the peoples who inhabit scattered islands at the river mouth. It is possible that originally they were a coastal people, who were driven inland by later arrivals. Their social organisation would seem to require a steady stream of captives for the supply of these reconstructed heads, which are obtained from the captives brought back to the Tugeri villages. The prisoners' legs are broken to prevent their escape and their death takes place only at the feasts that are held on the return of the raiders. The object of the raids is to secure the souls of the victims, and immediately before they are killed they are made to cry out by ill-treatment. Whatever cry is uttered is accepted as the name of the spirit. The word is treasured and the influence of the spirit, of which it is the name, will guard and benefit the captor. An outstanding feature of this type of preserved head is the fibre 'wig', which is added owing to the fact that most of the coast peoples have short hair. Lengths of fibre are close woven at their base to form a close-fitting cap which is attached to the scalp.

Bari Initiation.—Fr. L. M. Spagnolo contributes notes on the initiation of young men and girls among the Bari tribe of the Sudan to *Africa* (vol. 5, No. 4). Initiation of the youths was, in the days before the Bari were affected by white civilisation, one of the links between the chief and his people. When his son had reached the age of entering the ranks of the warriors, the chief would present him with a bull and bid him summon all the youths of his age-class, who henceforth would form his bodyguard. They assembled on an appointed day, a bull was killed with the usual ceremonies, and much beer drunk. The young chief of the class then announced the name by which his class would be known, this usually expressing some attribute such as courage, strength and the like. The name was chanted in all tribal songs sung at marriages, funerals and on similar occasions, and was used as a battle cry. The class formed a society with bonds which only death could sever. The custom is now falling into disuse. The initiation of young girls fell into five stages, which entailed cicatrisation at certain ages, beginning at about fifteen. In the fourth stage the initiates had the lower canines and incisors removed to mark the passage from girlhood to married status. No girl could marry unless she had undergone this stage of the ritual, and failure to comply caused infecundity. The neophytes lived in seclusion and the operation was carried out by a skilled operator with an iron instrument, sometimes reinforced by a stone. The period of seclusion was passed in singing, dancing, and in the preparation of a number of ceremonial objects. Certain taboos had to be observed. At the close of the period—about three months—suitors presented gifts to the girls and to the members of their family. The last tattooing takes place about two years after the extraction of the teeth, that is, when the girls are something over twenty years of age. Age classes, five for each sex, determine the joint of the fat ox to which participants are entitled at ceremonial feasts.

Contraception and Fertility in Women.—"Contraception and Fertility in 2,000 Women" by Raymond Pearl (*Human Biology*, vol. 4, September, 1932), is a preliminary report on the first 2,000 cases collected in an investigation of the prevalence and effectiveness of the use of contraceptives. The data are collected by physicians attending women who are undergoing parturition in the obstetric clinics of 38 large hospitals in the United States. As Prof. Pearl points out, selection is an important factor in the inquiry and the data cannot be regarded as a sample of the general population because there were no women from rural areas and all the women had been delivered of a baby in hospital. No data were collected from Roman Catholic hospitals. The cases were almost entirely from the lower economic and social levels; 70 per cent were white women and 30 per cent negroes. The average number of pregnancies was 2·68 for white women and 2·89 for negroes. It would appear from this sample of women that the practice of contraception is far less prevalent than is commonly supposed, for only about 36 per cent of white women and 15 per cent of negroes had made some attempt to prevent conception. The different methods of contraception used were such that the white men alone assumed 48·7 per cent of the responsibility of family limitation, the white women alone 49·3 per cent and the couples conjointly 2 per cent. Among the negroes, family limitation was practised more by the women; the males alone assumed only 33·1 per cent of the total responsibility, the women 64 per cent and the couples together 2·9 per cent. A new method is described for calculating person-years of exposure to risk of pregnancy. No definite conclusions are attempted in this preliminary study. There is some reason to think, though it is not yet demonstrated, that women who practise contraception are innately more fertile than women who do not.

Distribution of Bugs of the family Peloridiidæ.—The remarkable hemipterous family Peloridiidæ has formed the subject of a number of speculative and controversial papers during the last decade. The interest which these insects arouse is due partly to their excessive rarity but more particularly to their extremely puzzling relationships. Indeed, it proved necessary to establish a special series within the suborder Homoptera for this one family with its three genera, each with only one species. Practically nothing was known of the habits of these bugs and it is only recently that Hacker has published (*Queensland Agri. J.*, vol. 37, 1932) some authentic observations on the ecology of *Hemiodœcus veitchi*, which proved to be a forest insect associated with the antarctic beeches of the genus *Nothofagus*. On the basis of this discovery, W. E. China (*Ann. Mag. Nat. Hist.*, vol. 10, October, 1932) has analysed the distribution of other members of the family. One of

them, *Peloridium hammoniorum*, is known from the vicinity of the Straits of Magellan, where several species of *Nothofagus* occur; another, the New Zealand *Xenophyes cascus*, has been found in a locality where several species of *Notofagus* are known to occur; the habitat of the Tasmanian *Hemiodœcus leai* remains unknown, but a species of *Nothofagus* grows there. The existence of a species of *Nothofagus* in the McPherson Range in Queensland, together with the occurrence there of a peloridiid, suggests that the range in question can be regarded as a relic island of the ancient antarctic flora and fauna, comparable to the European Alps with their isolated arctic species of plants and animals.

Respiratory Organs of Isopod Crustacea.—Mr. Ernest E. Unwin has described the respiratory organs and their modifications found among various genera of terrestrial Isopoda forming the group Oniscoidea or wood-lice (*Papers and Proceedings, Roy. Soc. Tasmania*, 1931, pp. 37–104). These Crustacea inhabit very diverse situations, some requiring wet conditions while others live amid comparative dryness. In this connexion there are correlated modifications in the organs of respiration. In all cases the exopodites and endopodites of the first five pairs of abdominal appendages are respiratory in function. The endopodites are uniformly thick-walled, somewhat flattened sacs filled with blood. Their surfaces are coated with a film of water and the author concludes that they are capable of absorbing oxygen through the medium of this moisture layer. The exopodites, on the other hand, present greater structural diversity. In *Oniscus* and *Philoscia* there is a special thin extension of the outer border of the exopodites forming small lung chambers. In such cases the blood follows through radial passages in the thin-walled plate and the air bathes the surface of the special organ. In *Porcellio*, *Armadillidium* and other genera the outer wall of the exopodite is invaginated to form a branching system of very thin-walled air tubes. The blood within the cavity of the exopodite bathes the surfaces of the air tubes. The second method of respiration is comparable with the tracheal respiration of Insecta but the wood-lice are handicapped by the small size of the organs concerned and their inability to do without endopodites. These facts appear to have limited the range of wood-lice, since they have to seek situations favourable for both types of breathing.

Pedigree Strains of Herbage.—The results of the comprehensive trials with pedigree strains of herbage, carried out at the Welsh Plant Breeding Station, Aberystwyth, during the seasons 1926–1931, have been published from the Station as Bulletin No. 13, Series H. The evidence obtained shows how far we are at present from being in a position to lay down truly scientific rules for the maximum exploitation of grasses and clovers, but although much critical field experimentation is still needed before our knowledge can be translated into terms of practical grassland management, the information already obtained allows of certain important generalisations being made. For example, no two species or strains of grass react similarly to factors (such as grazing or nitrogenous manuring) which influence seasonal productivity, palatability or persistency, and as a means of securing the right type of herbage at the right season, a simplification of the botanical personnel of the swards in conjunction with a rotational system of grazing is suggested. As regards the live weight increase of sheep fed on the different pastures, the outstanding result is the exceptionally high feeding value of wild white clover. An increase in live weight and carrying capacity of the sward was also obtained by the application of a nitrogenous manure, although this entailed a decrease in the percentage of clover present. Chemical analyses carried out to determine the effect of dressings of nitrogen on the composition of the individual grasses show that the nutritive value and palatability of a pasture can, to a considerable extent, be controlled by careful selection of the most suitable species, coupled with judicious management.

Virus Diseases of the Peach.—Three virus diseases of the peach in Michigan are described by D. Cation, in Circular Bulletin No. 146 of the Michigan State College, Agriculture Experiment Station (pp. 1–11, 1932). The diseases known as 'peach yellows' and 'little peach' are well known in peach-growing districts, but the trouble known as 'red suture' is of more recent occurrence. The foliage of infected plants becomes bronze in colour, giving the tree an unhealthy appearance, and the fruits bear a distinct red ridge along the suture. The malady is transmitted by grafting and is, in all probability, a virus disease. The bulletin under review deals with the symptoms and control of all three diseases.

Crystallisation of Pyroxenes.—An important contribution to the current discussion as to the course of crystallisation of pyroxenes from rock magmas is made by S. Tsuboi (*Jap. J. Geol. Geog.*, 10, 67–82; 1932). Whereas Barth found that in the basaltic rocks of the Pacific, South Africa, India and Cape Verde the porphyritic pyroxenes are diopsidic, while those of the ground-mass are pigeonitic, Tsuboi finds that in the majority of Japanese andesitic and basaltic rocks both monoclinic and rhombic pyroxenes occur as phenocrysts. It is suggested that in the intratelluric stage crystallisation may begin with either type of pyroxene according as the composition of the original magma lies in the field of monoclinic or rhombic pyroxenes. Only a limited degree of miscibility prevails in this stage. In the effusive stage, however, there is no limit to the miscibility of the pyroxenes, and in the residual liquid that remains both components crystallise in a single pigeonite phase. This inference corresponds with the results obtained by Bowen in his experiments with artificial pyroxenes under pressure conditions like those of lava flows. The variation of the course of crystallisation with pressure changes as well as with changes of composition in the residual liquids makes it possible to understand more clearly some of the apparent discrepancies between fact and theory in the very complicated history of pyroxene crystallisation.

After-Shocks of the Hawke's Bay Earthquake of February 3, 1931.—A brief, but valuable, summary of the New Zealand earthquakes of 1931 is given by Dr. C. E. Adams and Dr. J. Henderson in Bulletin No. 84 of the Dominion Observatory, Wellington, N.Z. The outstanding feature of the year was the destructive Hawke's Bay earthquake of February 3, the epicentre of which lay on the coast-line of Hawke's Bay 5–15 miles north of Napier, and the focus at a depth of 10–15 miles. The frequency of the after-shocks, at first great, declined rapidly. During the rest of February 595 were recorded, but the number fell to 79 in March and 12 in December. Of the total number, 17 were of intensity 6 (Rossi-Forel scale)

or higher. A semi-destructive shock (intensity 8) occurred on February 13, with its epicentre close to the middle point of the chord joining the extreme points of the Bay. The positions of the epicentres of forty of the principal after-shocks of 1931 have been determined and are represented on the map accompanying the paper. It is remarkable how many of these epicentres lie along or close to the chord of the Bay and its continuations, that to the north passing close to Gisborne and therefore to the epicentre of the important after-shock of September 16, 1932 (NATURE, 130, 468; 1932).

Electrochemical Theory of Organic Reactions.—Two lectures by Prof. R. Robinson, published by the Institute of Chemistry, give a very convenient review of this subject, with a bibliography. Prof. Robinson dealt with the applications of the modern electronic theory of valency to organic reactions, taking up various aspects of the problem. The general or inductive effect due to the disturbance in electron arrangement owing to the presence of groups is considered in relation to the strengths of acids and bases. Reagents may be classified into anionoid, or electron donating, and cationoid, or electron accepting, which groups include reducing and oxidising agents, respectively. Electromeric changes constitute a second type of electron displacement which appears in the simplest form in the course of the saturation of olefines or the additive reactions of carbonyl compounds. There is then a tendency for electrons in the double bond to break away from carbon and become attached to oxygen. Normally, such changes have a very restricted amplitude except in the course of reactions. All reactions of unsaturated substances are considered to be preceded by a degree of electromeric polarisation. A classification of conjugated electromeric systems into polyenoid C=C–C=C; hetero-enoid –N–C=C (with N written as a trivalent centre); cationoid C=C–C=O; neutralised systems O–C=O; dicationoid and dicatio-enoid (quinonoid) O=C–C=O and O=C–C=C–C=O; and dissociating systems, such as the carboxylic type, are discussed. Prof. Robinson then dealt with polar symbols for inductive, field and electromeric effects, with examples; anionoid reactivity of aromatic types; ordinary aromatic substitution, and cationoid reactivity of aromatic types. These lectures bring together a large amount of interesting material in a logical sequence and are a very useful contribution to modern chemical theory.

Astronomical Topics

Comet 1932 *n* (Dodwell-Forbes).—This comet, the magnitude of which is between 10 and 11, was found independently by Mr. G. F. Dodwell, the Government Astronomer at Adelaide, and by Mr. A. F. I. Forbes at Hermanus, Cape of Good Hope. It is Mr. Dodwell's first comet and Mr. Forbes's fourth. The following observations are from U.A.I. Circulars 409, 410, 411 and 413:

U.T. 1932	R.A. 1932·0	S.Decl. 1932·0	Place
Dec. $17^d\ 13^h\ 0{\cdot}0^m$	$23^h\ 2^m\ 23^s$	28° 48′ ″	Adelaide
18 17 58·7	23 6 50·9	27 53 0	Johannesburg
19 0 17·4	23 7 45·0	27 41 33	Harvard

The time of the first observation was telegraphed as 1^h; but that was in daylight, and comparison with the other positions leaves little doubt that 13^h is correct. The Harvard observation was by Dr. Whipple and Mr. Cunningham; they have deduced the following elliptical orbit from their own observations on December 19 (beginning), 19 (end), and 21; the interval is so short that great precision cannot be expected:—

$$
\begin{array}{ll}
T & 1932\ \text{Dec.}\ 30{\cdot}27\ \text{U.T.} \\
\omega & 327°18' \\
\Omega & 79\ 53 \quad \} \ 1932{\cdot}0 \\
i & 23\ 52 \\
q & 1{\cdot}100 \\
e & 0{\cdot}7470 \\
\multicolumn{2}{l}{\text{Period } 9{\cdot}07 \text{ years}}
\end{array}
$$

Ephemeris for 0^h U.T.

	R.A.	S.Decl.
Dec. 30	$23^h\ 45^m\ 54^s$	18° 34′
Jan. 4	0 3 25	14 20
,, 9	0 20 45	9 38
,, 14	0 38 34	4 52
,, 19	0 56 52	0 1

The comet is nearest to the earth about January 17: distance 0·9 of a unit.

The comet does not appear to be identical with any previously observed. If T is in 1932, it makes the tenth observed comet to pass perihelion in this year. This number was only exceeded once; there were eleven perihelia in 1925, and ten in 1898; these are the only years with double figures. The number of discoveries in 1932 was thirteen, which is the greatest on record; but one of these comets passed perihelion in 1931, and two others were not sufficiently observed to enable their orbits to be computed.

Work of the Naval Observatory, Washington.—Vol. 13 of the publications of this Observatory contains interesting details of the observations of three total solar eclipses. That of January 1925 was observed from an airship, which was too unsteady for delicate photography; nevertheless, some interesting pictures are given of the spectrum of the chromosphere and corona; the former was traceable to λ8800, the latter to λ7100. The eclipse of 1926 was observed in Sumatra; there are two beautiful reproductions of coronal photographs taken with the 65-ft. camera. Pictures on a smaller scale, taken with a cinematograph, show a good deal of detail in the outer corona; the reality of the features shown is checked by comparing different images.

The 65-ft. camera was taken to Iloilo (Philippine Islands) for the 1929 eclipse; also an 11-ft. camera. Pictures with both of these are reproduced. The report contains a vivid account of the eclipse seen from an aeroplane.

The Sproul Observatory sent an expedition to Sumatra in 1929: an hour elapsed between totalities at the two stations. Comparison of coronal details on the Sumatra and Iloilo plates shows systematic outward motion. The mean velocity from ten coronal markings was 3·8 km./sec.; since there must be some foreshortening, the true speed is greater.

The volume closes with a discussion of errors of the moon's longitude from 1866 to 1929, based on the results of many observatories, and compared with Brown's tables. The observed-minus-tabular longitude was 0″ in 1871, −3″ in 1893, 0″ in 1902, +8″ (maximum) in 1922, +6″ in 1928. The residuals after removing the great empirical term are also given.

The Modern Radio-Meteorograph

THE difficulties and uncertainties of securing measurements of upper-air temperature, pressure, etc., by means of the customary *ballon sonde* are already well known. Considerable value therefore is attached to methods which cause the recording meteorological instruments to operate a small radio transmitter carried with them by the ascending balloon and sending out some form of distinctive signal which can be received immediately on the ground and used to compile a record of the elements concerned.

What is believed to be the first kind of such radio-meteorograph was devised a few years ago by Prof. Moltchanoff, of Leningrad, records of temperature and pressure being obtained in several test ascents in January, 1930. Considerable modifications have since been made in the design. Humidity records have been included as well as those of temperature and pressure, while the method of radio control now

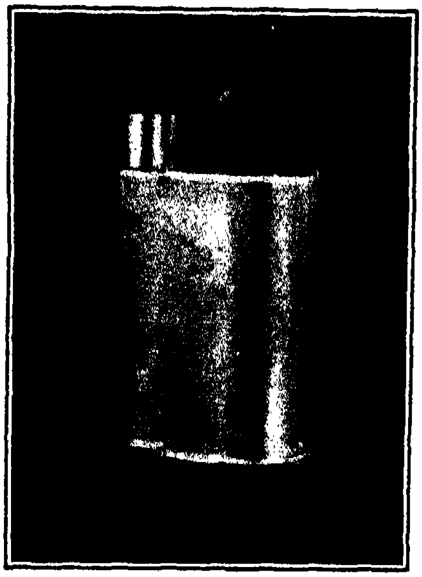

FIG. 1.

employed is such as to permit automatic recording by instruments of the rotating cylinder type such as are used for wireless picture reception.

The new pattern of Moltchanoff's radio-meteorograph is made by Askania-Werke of Berlin.

The apparatus consists essentially of a small short-wave radio transmitter (25-100 metres) located at the middle of a dipole antenna which trails below the balloon. The external appearance of the instrument is seen in Fig. 1. The disposition of the apparatus is shown in Fig. 2, which shows the wireless transmitter T and its small batteries B for filament heating and anode supply. The frequency of the transmitter is controlled by a quartz crystal in order to maintain constancy of frequency over the range of temperature encountered in practice. Special dry batteries have also been developed to withstand the lower temperatures, as difficulties were encountered with batteries of ordinary type. The batteries are additionally protected by thermal insulation in the course of their assembly into the transmitter.

The transmitter is of normal c.w. type and emits its signals under the control of a contact which makes or breaks its anode circuit in accordance with the elements to be signalled. The arrangement of this control is shown schematically in Fig. 3. A contact-arm A is rotated continuously by a clockwork drive. The three pointers of the appropriate measuring elements are arranged one above the other so that they move on a uniform circle, the top of each pointer making a fleeting contact with the brush of A in the course of its rotation. The brush also makes

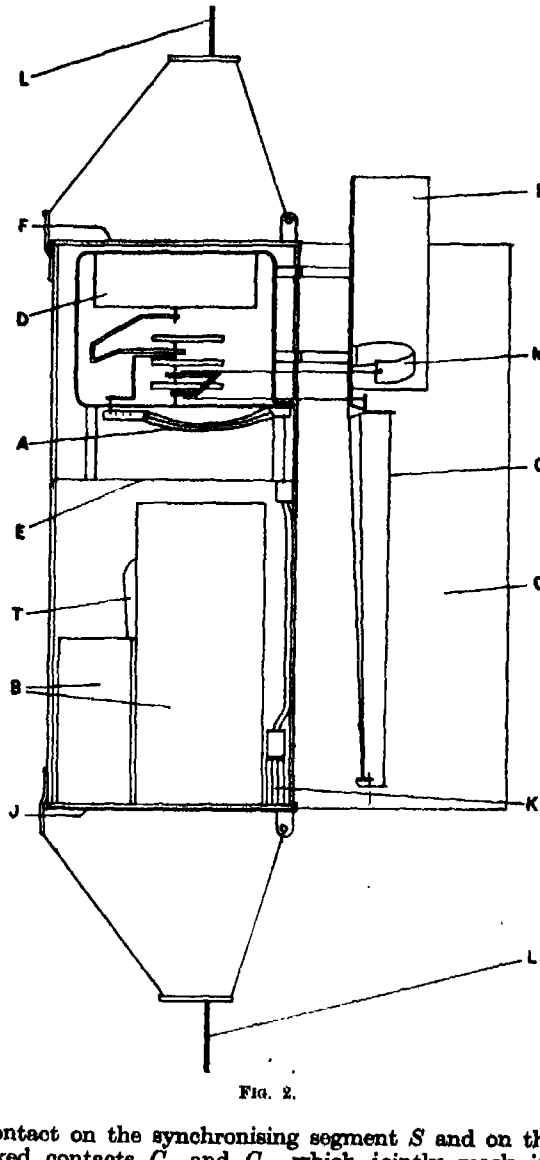

FIG. 2.

contact on the synchronising segment S and on the fixed contacts C_1 and C_2, which jointly mark its revolution into three parts, temperature, barometer and humidity respectively. The relatively long contact at S is for the purpose of emitting a longer signal in order to synchronise the recording cylinder at the receiver in a manner already well known in connexion with picture-receivers. The temporal interval between the end of the synchronising signal and the contact with the 'temperature' arm thus depends on the instantaneous position of the latter;

similarly the interval between the signal from C_1 and that from the 'barometer' arm depends on the positions of this pointer, etc. The contact has necessarily to be extremely light, and takes the practical form of a small elastic silver strip. Apart from mere weight, an additional need for lightness is that the contact should not sensibly disturb the position of the instrument pointers. The contact now in use is stated to be satisfactory in this respect, while it is to be noted that a slight disturbance, resulting in a lengthening of the signal, is immaterial in practice since it is the *first* instant of contact that marks the position of the pointer. The rotating arm A revolves once in 33 seconds.

Moltchanoff's original radio-meteorograph was intended primarily for aural receptions on a radio-receiver of normal pattern. The signal impulses were then arranged so as to permit ready aural identification with human interpretation of their meaning. The newer instrument now described is

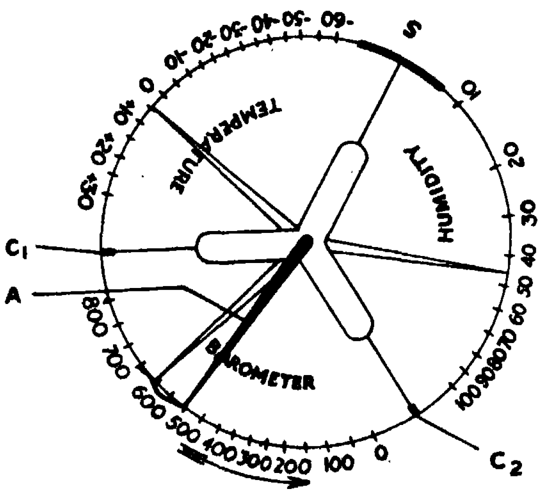

FIG. 3.

particularly designed for automatic recording, giving a record of the three elements which become normal Cartesian graphs by the addition of a scale of co-ordinates. Automatic recording is effected by an ordinary radio receiver followed by a picture-receiver of the rotating cylinder type. A suitable picture-receiver is that due to Prof. Dieckmann. This operates on principles, for example, of synchronising, etc., generally similar to those of the Fultograph receiver already well known in Great Britain, and need not be further described here. The type of record made by the Dieckmann receiver is shown in Fig. 4, which additionally shows the application of a scale of ordinate values covering the ranges measured by the instruments. A graduated graticule is available for application to the record for this purpose, a strip of it being added alongside the record of Fig. 4 to illustrate the assignment of scale values. The scale is applied by reference to the beginning of the signals from the fixed contacts C_1 and C_2.

The meteorological instruments are indicated in Fig. 2. The three measuring elements are the barometric diaphragm A, the bi-metal thermometer M and the hygrometer hairs C. The thermometer and hygrometer are housed in the air channel G, while the former is protected from radiation by the highly polished cylinder H. The clockwork motor which drives the contact-arm is shown at D, holes for winding and control being provided in the cover F. These are all supported on the plate E in the upper part of the casing. The transmitter and its batteries

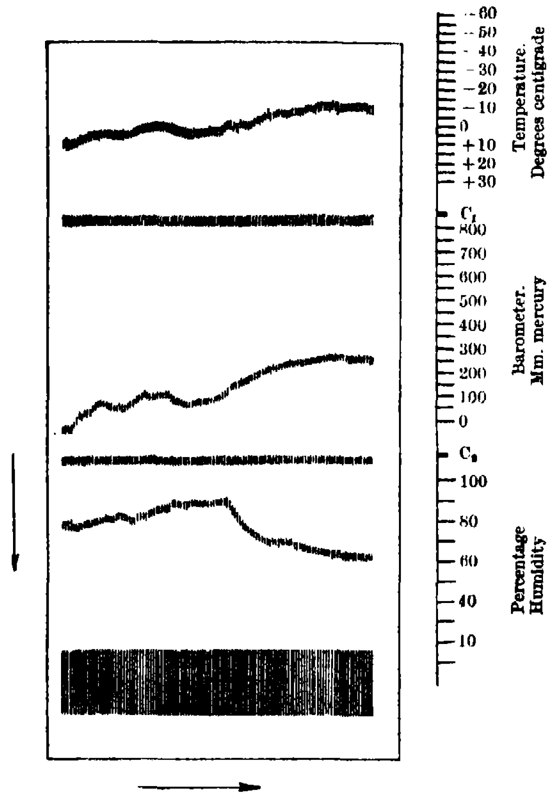

FIG. 4.

sit on an insulating sheet on the bottom-plate and can readily be withdrawn for adjustment or renewal. The plug K completes the circuit to the contact-arm and also to the leads L of the dipole antenna.

The various measuring instruments are calibrated by the makers before delivery. It is stated that the thermometer and barometer need not generally be recalibrated, but errors can readily be corrected should they develop. In the case of the hygrometer it is necessary to renew the hairs from time to time.

The complete instrument, as shown in Fig. 1, weighs only 2 kgm.; and recording ranges up to 100 km. have been achieved.

J. F. H.

International Association for Testing Materials

THE eighth meeting of the Permanent Committee of the International Association for Testing Materials was held on October 3–4 at Florence under the chairmanship of Dr. Walter Rosenhain, president of the Association. The Committee reviewed the financial position of the International Association and decided to issue a letter, through the president, directing the attention of certain countries to their moral obligations to the Association. Some countries, notably Switzerland, have already contributed more

than their quota and it is hoped that the remaining countries will also make an adequate response to the financial appeal which the Committee has been obliged to make.

The completion and issue of the "Book of the Congress of Zurich in 1931" was reported, and the desirability of securing the further sale of this volume was emphasised. It is believed that the nature and value of this publication have not yet become fully known to many of those who might be interested in it, so that a much larger sale should be attained; this is highly desirable if the future work of the International Association is to go forward vigorously.

The main question dealt with by the Permanent Committee at the Florence meeting was the plan of work to be undertaken at, and in preparation for, the congress which is to be held in London in 1935. It was decided in general terms that the work of the congress should again be organised on lines similar to those which had proved particularly successful at Zurich. The work of the congress will therefore be carried out in four sections or groups, namely: A, Metals (president, Prof. C. Benedicks, Sweden); B, Inorganic Materials, including stone, cement, concrete, etc. (president, Prof. E. Suenson, Copenhagen); C, Organic Materials (president, Dr. F. Barta, Prague); and D, Questions of general importance. For Group D the late Dr. Burgess of Washington had been appointed president. His untimely death unfortunately renders it necessary to appoint a new president for this Group, but the appointment has not yet been made as it was thought desirable to await suggestions from various countries. In each of these Groups only a limited number of subjects will be discussed, the whole of one session being devoted, as was done at Zurich, to the discussion of a single question or group of questions. The selection of subjects with which it is proposed to deal has been provisionally made as follows:

Group A: Corrosion, light alloys, welding, progress of metallography, behaviour under machining and abrasion.

Group B: concrete and ferro-concrete, testing methods for ceramic materials, weathering of natural and artificial stone.

Group C: textiles (artificial silks), wood cellulose, india-rubber (cautchouc), preservation of timber.

Group D: progress in testing machines and measuring appliances, materials of construction in the laboratory and in service, methods and concepts of physics and chemistry in their application to problems of testing materials, sound and heat transmission of materials.

While it has been thought desirable to lay down in these general terms the subjects to be discussed at the congress in London, it is realised that in the intervening period developments may occur which may make an alteration of this programme desirable.

In view of the financial stringency which the International Association feels, in common with the industrial and technical world upon which it depends for support, it may not be possible to issue any intermediate publications such as those issued some eighteen months before the congress at Zurich. None the less, the work of the Association will be carried forward actively, mainly through the presidents of the four Groups and also by a number of international committees which have been appointed. The latter will carry on their work almost entirely by correspondence, but meetings in connexion with them will take place at or immediately prior to the congress in London in 1935.

In spite of exceedingly difficult circumstances, it will be seen that the International Association for Testing Materials is carrying on its work in an active and energetic manner, and an appeal is made for support in all countries both from societies, institutions and industrial firms, and also from all those individuals who are in one way or another concerned with the problems of testing.

The secretariat of the International Association is at Zurich (Leonhardstrasse 27) and Prof. M. Roš, head of the Swiss Federal Testing Laboratory, has consented to retain the office of general secretary until the congress in London. The British headquarters of the association are in the hands of Mr. G. C. Lloyd (honorary secretary and treasurer) at the offices of the Iron and Steel Institute, 28 Victoria Street, London, S.W.1.

Air Waves from Experimental Explosions

THAT the audibility of explosions must be due in some wey to conditions in the upper air at considerable heights above the ground has long been recognised. It is therefore appropriate that experimental explosions should be included in the programme of intensive meteorological research during the Polar Year. The first experiments to be organised in accordance with this programme by Prof. H. Hergesell, president of the International Commission for the Investigation of the Upper Air, took place on December 15. These explosions were at Russian Harbour in Novaya Zemlya and at Oldebroek in Holland. At each place there were to be four explosions, at 6.0, 6.6, 7.0 and 7.6 G.M.T. Four Kühl undographs were to be operated in the neighbourhood of the Russian Harbour explosions, three in Novaya Zemlya and one in Franz Josef Land. Several undographs were to be used in Germany and one, at Flushing, in Holland. For co-operation by Great Britain, the sound-ranging apparatus which is in regular use for recording at Birmingham, Bristol, Cardiff and Nottingham the air waves caused by firing at Woolwich, was available, as well as similar apparatus at Foulness near the mouth of the Thames and at Hythe near Folkestone.

According to newspaper reports, the explosions at Oldebroek were not heard over any large area. The air waves were recorded at Potsdam and at Lindenberg. It is surmised that the photographic records from the other stations in Germany would be sent to a central point to be developed, so that some delay in the announcement of results is to be anticipated.

There was no reception of the air waves at Foulness, Hythe or Nottingham. Definite information is not yet available from Birmingham and Bristol. At the Cardiff station, Cefn Mably, Dr. J. Shaxby obtained a series of records showing disturbances, mostly minute, which were at first thought to indicate the reception of waves from the explosions at Oldebroek, but this interpretation is very doubtful.

Of the reports which have reached the Superintendent of Kew Observatory, in response to a

notice issued to the Press by the Air Ministry, one of the most valuable is from Miss Mabel Williams, who noticed at Cambridge that the window of her room vibrated vigorously at 6.21½, at 6.26½ and again at 7.26½. Sir John and Lady Smith, who were listening at Havering-atte-Bower in Essex, report that, between 19 and 22 minutes after 7, hundreds of birds in the trees surrounding their house suddenly made startled cries as if in danger. A considerable number of people in various parts of England have reported that they heard noises, which they attributed to the experimental explosions, but there was no area in which the sounds attracted general attention, and observers who listened with the intention of timing the series were not successful.

It is in accordance with previous experience that the infra-sonic waves, which carry most of the energy of an explosion, can be effective at great distances, at places where no sound can be perceived by ear. In the present case, the infra-sonic waves seem to have passed over Foulness to make the twigs quiver in the trees at Havering-atte-Bower and to shake the window at Cambridge. The distance from Oldebroek to Cambridge is 400 km.

University and Educational Intelligence

LONDON.—The title of reader in petrology in the University of London has been conferred on Dr. Alfred Brammall in respect of the post held by him at the Imperial College—Royal College of Science.

THE problem of the deaf, especially of their education, training and employment, is dealt with exhaustively in a report by Dr. A. Eichholz (London, H.M. Stationery Office, pp. 206, 3*s*.). The report is based on an investigation begun in April 1930, with the object of clearing up the facts upon which various representations have been made from time to time since 1924 (when the National Institute for the Deaf was founded) to Parliament and to the Ministry of Health and the Board of Education. Comprehensive statistics of the incidence of deafness in adult life are lacking, but indications that deafness of a disabling character exists in a marked degree among the general population are afforded by rejections for ear-diseases of applicants for service in the Army (5 per cent) and Royal Air Force (2 per cent). Among children, some gratifying decreases, attributable to arrangements by local education authorities for inspection and treatment, are reported. The statistics of deaf and dumb children also show a gradual decrease, attributable to improvement in the general health supervision of the population, from 4,173 in 1924 to 3,621 in 1930. The report suggests, *inter alia*, that arrangements for the detection of defects of hearing should be improved by the use of acoumetric apparatus such as the audiometer now used in many American cities, that the Ministry of Health and Medical Research Council should institute a study of the age incidence, causes and treatment of ear defect, that provision for vocational courses for deaf people should be made in the north, west and midland districts of England and in South Wales, and that a secondary school for the deaf should be provided.

THE International Federation of University Women (Crosby Hall, Cheyne Walk, S.W.3) has published a full report of its sixth conference, held last August at Edinburgh. Created, mainly on American and British initiative, in the year following the War as a means of promoting international understanding and friendship, this organisation has year by year extended its membership until it now comprises, in addition to those of the United States and the British Empire, associations of university women of every country of Europe (outside Russia), and Egypt, Palestine, Mexico and Brazil. The list of participants in the conference reaches the imposing total of 575 and although the American and British largely predominated, thirty countries in all were represented. Among the subjects dealt with were: international aspects of the development of science, co-ordination of university standards, the contribution of women to the newer knowledge of nutrition, epidemics of plant diseases and, in one of the sectional meetings, the careers open to women biologists. At this sectional meeting there was a consensus of opinion that it is far more difficult for women than for men to obtain work as biologists, that this is not due to their unsuitability for any of the kinds of work available (with the possible exception of certain kinds of tropical field work) and that there is consequently a waste of women biologists. Two members undertook to investigate this matter. Statistics of membership of the affiliated associations show that seventy per cent of the aggregate total are American university women. These constitute the financial backbone of the Federation. The German membership decreased heavily in 1932, while the Austrian increased by *seventy-six per cent*.

EDUCATION in Belgium is described by Dr. J. F. Abel, of the United States Office of Education, in a pamphlet of 145 pages prepared after investigation on the spot last year and now published by the Government Printing Office, Washington. One of the most striking facts to which Dr. Abel directs attention is the very heavy enrolment in the kindergartens —nearly a quarter of a million; this being nearly as large a proportion of the total number of children of kindergarten age as the proportion of the enrolment in primary schools to the number of children of primary school age. The secondary school curricula in Belgium have lately been remodelled so as to lessen school work and give more opportunity for recreation and physical development, the number of school hours being limited to 34 a week and teachers being warned that assigning tasks for home study is generally useless, and that it is habit rather than subject matter that the pupil is to acquire. Physical and biological sciences figure in the curricula of all divisions of secondary schools, but the time allotted is in general only two hours a week. Commenting on the problems arising out of bilingualism, Dr. Abel observes that the Belgians have proved that language unity is not necessary to, or perhaps advantageous for, national unity where appropriate arrangements are made in the schools. In the attempt to give effect to the principle of equal instruction for equal intelligence, very elaborate procedures have been prescribed for the guidance of the committees entrusted with the task of selecting children in primary schools for bursaries; the model school card enumerates forty-one characteristics to be estimated in the case of each pupil. An interesting account is given of the Colonial University, which selects annually twenty young men who contract to serve at least three years in the Congo after a four years' course.

Societies and Academies

LONDON

Physical Society, Dec. 16.—Allan Ferguson and J. T. Miller: A method for the determination of the specific heats of liquids, and a determination of the specific heats of aniline and benzene over the approximate range 20° to 50° C. The specific heats of aniline and benzene are determined by measuring the electrical power E^2/R necessary to hold the temperature of a calorimeter and its contents steady at various temperature-excesses.—**E. V. Appleton and G. Builder**: The ionosphere as a doubly refracting medium. In a previous communication the occurrence of wireless echo doublets was described and was provisionally attributed to the influence of the earth's magnetic field on the dispersive properties of the ionosphere. A more extended study of the subject, which has included an experimental determination of the polarisations of the doublet components, has confirmed this hypothesis. In south-east England, for ionospheric reflection at vertical incidence, the echo component of lesser delay is in general of right-handed, and the component of greater delay of left-handed, circular polarisation, but this temporal sequence should be reversed in the southern hemisphere and in certain special circumstances in the northern hemisphere.—**M. Taylor**: The Appleton-Hartree formula and dispersion curves for the propagation of electromagnetic waves through an ionised medium in the presence of an external magnetic field. (1) Curves for zero absorption. The curves are drawn to show the value of the squares of the indices of refraction and attenuation as functions of the electron density for a series of twelve frequencies, which are chosen to illustrate the various classes of curve and the boundary curves separating the classes and, in the case of frequencies of more than 1·321 megacycles per second, the various regions of short and ultra-short waves. The derivation and general properties of the Appleton-Hartree formula and the various possible modes of propagation are also discussed. The disperson curves are classified according to the infinities they contain and a diagram is given to show how the classes of curve holding for any angle of inclination of the direction of propagation to the magnetic field H depends on the ratio of the longitudinal component of H to H itself.—**L. F. Bates**: A new apparatus for the measurement of the earth's magnetic field. A small cylinder of mumetal is wound with fine wire, the ends of which are connected to wires forming a torsional suspension. This cylinder is placed with its centre at the mid-point of a Helmholtz coil system with its axis adjusted to coincide with the direction of the component of the earth's field which is to be measured, the suspension being perpendicular to the component. The current through the coil system can be adjusted so that there is no deflection of the suspended cylinder when the current in the solenoid wound upon it is reversed, in which case the calculated field produced by the coils is equal to the required component.—**E. G. Richardson and E. Tyler**: The flow of liquid suspensions. Measurements of the velocity from point to point in a liquid rotating in the space between two concentric cylinders, of which the outer rotates while the inner is still, have been made by means of a hot-wire anemometer. In a suspension, the velocity gradients are abnormal but can be explained in terms of a variable viscosity, which is a function of the velocity gradient.—**Lewis Simons and E. H. Smart**: A model to illustrate the motion of a diatomic rotator with two degrees of freedom. An arm 5 in. long is pivoted at one end and carries at the other end a small electric lamp which is thus capable of moving on the surface of a sphere about the pivot as centre. The two angular velocities $\dot{\Phi}$ and $\dot{\theta}$ can be independently controlled by two hand-regulated motors: Φ is the azimuthal and θ the co-latitudinal angular co-ordinate of the arm. If $\dot{\Phi}$ and $\dot{\theta}$ are commensurable, the resulting figure traced out by the lamp remains stationary in space. This path represents the motion of one of the atoms of the rotator, which has two degrees of freedom.

PARIS

Academy of Sciences, Nov. 7.—J. Costantin: The secret of Java. An account of the methods used to combat the sugar cane disease (Sereh) of Java, with special reference to the favourable effects of growing the young shoots at high altitudes.—**Bertrand Gambier**: Ruled algebraic surfaces and their singularities.—**Potron**: Certain conformal transformations in a Riemann space.—**Vignaux**: Riemann's method of summation.—**Nikola Obrechkoff**: The summation of the Fourier trigonometric series and conjugated series.—**P. Papcovitch**: General expressions for the components of stresses, containing as arbitrary functions only harmonic functions.—**J. Haag**: The improvement of the isochronism of pendulums by the use of elastic stops. The method is not new, but has hitherto been based empirically on experiment. A theoretical study is given, defining the characteristics of the best arrangement.—**R. Thiry and L. Sackmann**: A special arrangement of the stream lines in front of an obstacle. Outline of an experimental method with a hydrodynamic tunnel, with some preliminary results.—**P. Idrac**: Ultra-sensitive recorders of variation of altitude and temperature for aeroplanes.—**Kivelivotch**: Some particular cases of the problem of three bodies with impacts.—**Th. V. Ionescu and C. Mihul**: Ionised gases in the magnetic field: pressures below 0·001 mm. mercury. Continuation of experiments on the influence of pressure and of water vapour on the conductivity of ionised gases. Curves are given showing the conductivity as a function of the magnetic field.—**G. Athanasiu**: The sensibility in the spectrum of photo-cells with electrodes of copper covered with cuprous oxide. It is concluded that, in general, a copper electrode covered with a thin layer of cuprous oxide and dipped into neutral or alkaline electrolytes gives a negative E.M.F. on illumination. The effect commences at about 6500 A., increases as the wave-length diminishes, reaches a maximum and diminishes again towards the extreme violet of the visible spectrum. The method of preparing the film affects the results.—**E. Carvallo**: The effect observed by Miller at Mount Wilson was the Esclangon effect. The author gives another interpretation of Miller's experiments. He regards them as confirming and generalising Michelson's law, that the earth's velocity introduces no difference of path between the two rays of the interferometer.—**Yves Rocard**: The theory of critical opalescence.—**S. Y. Sze**: The β-rays emitted by the active deposit of actinium.—**Francis Perrin**: The average life of activated atomic nuclei. Probable cases of the impossibility of the γ-emission.—**G. I. Costeanu**: The measurement of electromotive forces in liquid ammonia. Details of the experimental

method and data for two cases.—**B. Bogitch**: The use of diaphragms in the commercial electrolysis of metals. Advantages are claimed for the use of impermeable diaphragms. High purity of the anodes is less necessary; the cathodes can be as pure as desired and the volume of electrolyte in circulation is considerably reduced. There is one disadvantage: there is an increase in the electrical energy used—about twenty per cent in the apparatus described.—**Mlle. Suzanne Veil**: Rhythmic phenomena observed in the electrolytic precipitation of colouring matters.—**Mme. Ramart-Lucas** and **M. Trivédi**. Colour and chemical behaviour in the cinnamic series.—**E. Darmois** and **R. Chalin**: The cryometry of some electrolytes in the fused hydrate $CaCl_2, 6H_2O$.—**E. Vellinger**: The superficial properties of india-rubber.—**A. Demolon** and **E. Bastisse**: The influence of the anions on the flocculation of colloidal clay by potassium salts.—**André Chrétien** and **Pierre Laurent**: A method of physicochemical analysis in organic solution by measuring the specific inductive power. Variations of the dielectric capacity can serve to detect acid and basic characters in the absence of water. Thus in benzene solution, mixtures of quinoline and phenol give indications of the formation of a combination of equal molecules.—**Pierre Jolibois** and **Louis Cloutier**: The basic salts of lead.—**Firmin Govaert**: The determination of the halogens in organic substances by the sodammonium method.—**P. Carré** and **D. Libermann**: The chlorides of the arylsulphurous acids and mixed aryl and alkyl sulphites. Thionyl chloride and aryl sulphite react according to the equation $SO(OAr)_2 + SOCl_2 = 2ArO.SOCl$. The chloride thus formed cannot be distilled without decomposition, but its existence is proved by its reactions, notably with formic acid and with alcohols. Mixed aryl alkyl sulphites are formed in the latter reaction.—**Georges Lévy**: Some derivatives of β-ethylnaphthalene.—**Pierre Bedos** and **Adrien Ruyer**: Some reactions of cyclohexadiene.—**A. Demay**: The existence of an antestephanian arc and on the continuity of the apparent thrusts towards the exterior of the arc from the Lyonnais to Corrèze.—**Jean Goguel**: The tectonic of the Luberon (Provence).—**Jacques Fromaget**: The structure of the indosinides.—**A. Rivière**: Contribution to the study of the Palæozoic of the central Elbourz.—**Jean Legrand**: The utilisation of observations of height indicators on rivers for the purpose of research on climatic cycles.—**J. Lacoste**: An earthquake with Mediterranean epicentre.—**Jean Lugeon**: The solar eclipse of August 31, 1932, and investigation by atmospherics.—**St. Jonesco**: The movements of the flowers of *Ipomœa purpurea*. The flowers of this species are continually in motion from the bud stage to the formation of the fruit.—**P. Martens**: Alternation of phases and sexuality in a conidian cycle in *Pholiota aurivella*.—**F. Obaton**: The presence of saccharose in the branches and leaves of *Euonymus europœus*.—**Jean Chaze**: The existence of a new active principle in *Bryonia dioica*.—**Raoul Lecoq**: The B vitamins and the utilisation of the lipides. The assimilation of lipides by the organism, like proteins and glucides, requires the presence in the ration of sufficient quantities of B vitamins.—**J. Giaja** and **Ilija Dimitrijević**: The influence of the surrounding temperature on the effect of pyretic substances.—**Marcel Florkin**: The dissociation curve of oxyhæmerythrin in the cœlomic liquid of *Sipunculus*.—**Charles Dubois**: The specificity of the allergic reaction as a method of diagnosis of ovine melitococcia.

Geneva

Society of Physics and Natural History, Nov. 17.—**E. Friedheim**: Two accessory respiratory ferments of animal origin. The tegumentary pigments of *Halla parthenopea* and of the sea urchin, *Sphœrechinus granularis*, possess the function of very considerably increasing the respiration of non-impregnated eggs of sea urchins and of non-nucleated red blood corpuscles. It is a case of catalysis due to the reversibility of the oxidation and reduction of the pigments. The Halla pigment can be titrated electrometrically.—**P. Rossier**: (1) Spectrophotographic photometry. The author gives a second approximation of the coefficients of experimental formulæ established before.—(2) The rôle of atmospheric humidity in astronomical photography. Certain coefficients of the formulæ studied in the preceding paper vary with the vapour pressure of atmospheric moisture.—(3) The refraction correction to be applied to differential astronomical observations. Micrometric observations of precision are vitiated by atmospheric refraction if the two stars observed are of different colours. The constants of spectral sensibility of the eyes now appear to be sufficiently well known to render it possible to calculate the effect. These systematic errors may be too large to be neglected.—**J. Weigle**: The orientation of non-polar molecules by a dipole. The author shows that a molecule with a permanent electric moment placed in a medium the molecules of which are non-polar but anisotropic, produces an orientation of these molecules. This orientation of the neighbouring medium should affect either the measurement of the permanent electric moment or the refractive index of the medium. By measuring the latter the author shows that interesting information on the form and structure of the molecules can be obtained.—**Ch. H. Wakker** and **B. Susz**: A rapid method of quantitative spectroscopic analysis. The method consists in carrying out a photometric measurement of a selected line of the spectrum emitted by the element to be determined. The measurement is made by direct observation with the spectroscope without making use of photography.—**E. Briner** and **H. Biedermann**: Ozone the only persistent allotropic form of oxygen produced in appreciable quantity by the silent electric discharge. The products resulting from the action of the silent discharge on oxygen, working with different forms of apparatus both at low and high frequency, were submitted to fractional distillation. No allotropic modification of oxygen other than ordinary ozone could be found.—**R. Wavre**: The polydromes of potentials.—**H. Lagotala** and **Ch. Couchet**: Note concerning the tectonic of the cupriferous region of the middle Congo. The authors have proved the mylonitised zones in the grits, limestones and at the contact of the grits and limestones. They have remarked the frequency of the sub-horizontal movements and the presence of laminations some of which are mineralised. In certain cases a single layer is separated for a considerable distance. The age of these separations appears to be earlier than the formation of the faults.—**G. Tiercy**: The hypothesis of continental drift: the chronological succession of the first upholders. The order given is as follows: 1668, Le R. P. Francois Placet: 1858, Antoine Snider Pelegrini: 1889, R. Mantovani: 1890, J. A. Boulanger.

Washington, D.C.

National Academy of Sciences (*Proc.*, 18, 609–632, Oct. 15, 1932).—**Thomas Wayland Vaughan**: The fora-

minifera genus *Orbitolina* in Guatemala and Venezuela.—**Thomas Wayland Vaughan** and **W. Storrs Cole**: Cretaceous orbitoidal Foraminifera from the Gulf States and Central America. A new type of orbitoid from the Upper Cretaceous of the Gulf coastal plain and another specimen, both from oil well cores, are described and illustrated.—**Robert Balk**: Structure and correlation of metamorphic rocks in south-eastern New York. The older view, due to Dana and Merrill, following Mather, regarded the metamorphic sediments of this area as equivalents of the fossiliferous Cambro-Ordovician sequence north-west of the Hudson Highlands. Later, Berkey tentatively regarded the highly metamorphic series as Pre-Cambrian. Detailed field work over the area, of which a long abstract with map and diagrams is given, supports the older view.—**Sterling Emerson**: Chromosomes rings in *Œnothera*, *Drosophila* and maize. It is suggested that the postulates of 'inverted section' and 'differential segments' are not in accord with published data and are unnecessary to account for the small amount of crossing-over observed.

Forthcoming Events

CONFERENCE OF EDUCATIONAL ASSOCIATIONS, Jan. 2–9. At University College, Gower Street, W.C.1.
The Right Hon. the Earl of Athlone: Presidential Address on Jan. 4, at 3.
Joint Conference on "The Trend of Education". Speakers: H. Ramsbotham, Miss W. Mercier and J. E. Barton, on Jan. 2, at 5.

PHYSICAL SOCIETY, Jan. 3–5. Twenty-third annual exhibition of scientific instruments and apparatus at the Imperial College of Science and Technology, South Kensington, S.W.7, at 3–6 and 6–10.
Dr. Allan Ferguson: "Surface Tension and its Measurement", on Jan. 3, at 8.
R. A. Watson Watt: "Cathode Ray Oscillography", on Jan. 4, at 8.
F. Hope-Jones: "Time Measurement: Old and New", on Jan. 5, at 8.

SCIENCE MASTERS' ASSOCIATION, Jan. 3–6. Annual Meeting at the University of Bristol.
Prof. A. M. Tyndall (Presidential Address): "Gaseous Ions".

GEOGRAPHICAL ASSOCIATION, Jan. 4–6. Annual Conference at the London School of Economics and the Imperial Institute.
Dr. H. R. Mill (Presidential Address): "An Approach to Geography", on Jan. 4.

MATHEMATICAL ASSOCIATION, Jan. 5–6. Annual Meeting at the Institute of Education, Southampton Row, London, W.C.1.
Prof. G. N. Watson (Presidential Address): "The Marquis and the Land Agent: a Tale of the Eighteenth Century", on Jan. 5, at 3.45.
Discussion on "The Study of Statistics in a School Course", to be opened by F. Sandon, on Jan. 6, at 2.15.

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Society. Series A, Vol. 138, No. A836, December 1. Pp. 479–722. (London: Harrison and Sons, Ltd.) 12*s*.

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 6: Observations on the Cytology of *Opalina ranarum* and *Nyctotherus cordiformis*. By Ruth Patten. Pp. 73–94 + plates 6–7. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

The Journal of the Ipswich and District Natural History Society. Edited by Henry Ogle. Vol. 1, Part 3, November. Pp. 141–196. (Ipswich.)

Proceedings of the Linnean Society of London. Session 1931–32, Part 6. Pp. 167–220. (London: Linnean Society.) 2*s*.

The Salters' Institute of Industrial Chemistry. Pp. 28. (London: The Salters' Institute.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 71, No. 432, December. Pp. 837–992 + xii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 7: Some Noteworthy Plants found in or reported from Ireland. By Dr. R. Lloyd Praeger. Pp. 95–124. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1475 (T.3264): Arithmetical Solution of Problems in Steady Viscous Flow. By Dr. A. Thom. Pp. 6 + 3 plates. 6*d*. net. No. 1477 (T.3260): Slotted R.A.F. 34 Bristol Fighter—Forces on Slat in Flight. By A. Ormerod. Pp. 6 + 15 plates. 1*s*. net. No. 1490 (T.3270): Aerodynamic Characteristics of a Semi-Rigid Wing. By A. G. Pugsley. Pp. 11 + 4 plates. 9*d*. net. (London: H.M. Stationery Office.)

Dove Marine Laboratory, Cullercoats, Northumberland. Report for the Year ending June 30th, 1932. Edited by Prof. Alexander Meek. Pp. 42. (Cullercoats.) 5*s*.

University College of the South-West of England, Exeter. Proceedings of the College Field Club and Natural History Society, 1930–31. Pp. 23. (Exeter.)

OTHER COUNTRIES

University of Wisconsin Studies in Science. No. 5: Root Nodule Bacteria and Leguminous Plants. By Edwin Broun Fred, Ira Lawrence Baldwin and Elizabeth McCoy. Pp. xxii + 343 + 47 plates. (Madison, Wis.) 3 dollars.

Proceedings of the United States National Museum. Vol. 81, Art. 12: Report on the Hexactinellid Sponges collected by the United States Fisheries Steamer *Albatross* in the Northwestern Pacific during the Summer of 1906. By Yaichiro Okada. (No. 2935.) Pp. 118 + 6 plates. Vol. 82, Art. 2: A New Paleocene Mammal from a Deep Well in Louisiana. By George Gaylord Simpson. (No. 2943.) Pp. 4. Vol. 82, Art. 3: The Chinese Lizards of the Genus Gekko. By Leonhard Stejneger. (No. 2944). Pp. 8. Vol. 82, Art. 4: Description of a Tick, *Dermacentor halli*, from the Texas Peccary, with a Key to the North American Species of Dermacentor. By Allen McIntosh. (No. 2945.) Pp. 6 + 1 plate. (Washington, D.C.: Government Printing Office.)

The Journal of the Astronomical Society of South Africa. Edited by Dr. H. Spencer Jones. Vol. 3, No. 2, November. Pp. 61–100. (Cape Town.) 2*s*.

Smithsonian Institution: Bureau of American Ethnology. Bulletin 106: Ethnographical Survey of the Miskito and Sumu Indians of Honduras and Nicaragua. By Eduard Conzemius. Pp. vii + 191 + 10 plates. (Washington, D.C.: Government Printing Office.) 25 cents.

U.S. Department of the Interior: Office of Education. Bulletin, 1931, No. 20: Biennial Survey of Education in the United States, 1928–1930. Chapter 6: Statistics of Public High Schools, 1929–30. By Emery M. Foster and Russell M. Kelley; with the co-operation of Carl A. Jessen. Pp. 95. (Washington, D.C.: Government Printing Office.) 10 cents.

Cornell University: Agricultural Experiment Station. Bulletin 539: An Economic Study of Agriculture in Northern Livingston County, New York. By Stanley Whitson Warren. Pp. 244. (Ithaca, N.Y.)

Bulletin of the American Museum of Natural History. Vol. 63, Article 6: The Vertebral Columns of Ricochetal Rodents. By Robert Torrens Hatt. Pp. 599–738 + plates 11–20. (New York City.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Ann[illegible] No. 11, Novembre. Pp. 473–520. (Prague: Regia Societas Scie[illegible] Bohemica.)

U.S. Department of the Interior: Office of [illegible]ucation. Pamphlet No. 32: Institutions of Higher Education in Sweden. By Alina M. Lindegren. Pp. v + 45. 10 cents.

Smithsonian Miscellaneous Collections. Vol. 87, No. 13: The Functions of Radiation in the Physiology of Plants. 1: General Methods and Apparatus. By F. S. Brackett and Earl S. Johnston. (Publication 3179.) Pp. 10 + 1 plate. Vol. 87, No. 14: The Functions of Radiation in the Physiology of Plants. 2: Some Effects of near Infra-red Radiation on Plants. By Earl S. Johnston. (Publication 3180.) Pp. 15 + 4 plates. Vol. 87, No. 15: An Improved Water-Flow Pyrheliometer and the Standard Scale of Solar Radiation. (Roebling Fund.) By C. G. Abbot and L. B. Aldrich. (Publication 3182.) Pp. 8 + 1 plate. (Washington, D.C.: Smithsonian Institution.)

Division of Fish and Game of California: Bureau of Commercial Fisheries. Fish Bulletin No. 37: The California Barracuda (*Sphyræna argentea*). 1: Life History of the California Barracuda; 2: A Bibliography of Barracudas (*Sphyrænidæ*). By Lionel A. Walford. (Contribution No. 112 from the California State Fisheries Laboratory.) Pp. 120. (Terminal, Calif.: California State Fisheries Laboratory.)

Census of India, 1931. Vol. 2: The Andaman and Nicobar Islands. Part 1: Report; Part 2: Tables. By M. C. C. Bonington. Pp. viii + 119. (Calcutta: Government of India Central Publication Branch.) 5 rupees; 7*s*. 6*d*.

CATALOGUES, ETC.

Degussa Products for Stringent Chemical and Thermal Requirements. Pp. 12. (London: Bush, Beach and Gent, Ltd.)

Mercury Switches and Relays for Industrial and Laboratory Control. (List No. M.1132.) Pp. 32. (London: Isenthal and Co., Ltd.)

Calendar for 1933. (Newcastle-on-Tyne: C. A. Parsons and Co., Ltd.)

Calendar for 1933. (London: F. E. Becker and Co.)

The X-Ray Metallurgical Crystallograph for the X-Ray Examination of the Effects of Heat and Mechanical Treatment on Metals. (Publication 173/2.) Pp. 5. Bulletin No. 4: Spectrum Analysis. (Publication No. 183.) Pp. 12. (London: Adam Hilger, Ltd.)

A Catalogue of Books on Botany, Agriculture, Forestry, Fruit Culture, Gardens and Gardening, Herbals. (No. 467.) Pp. 98. (London: Bernard Quaritch, Ltd.)

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